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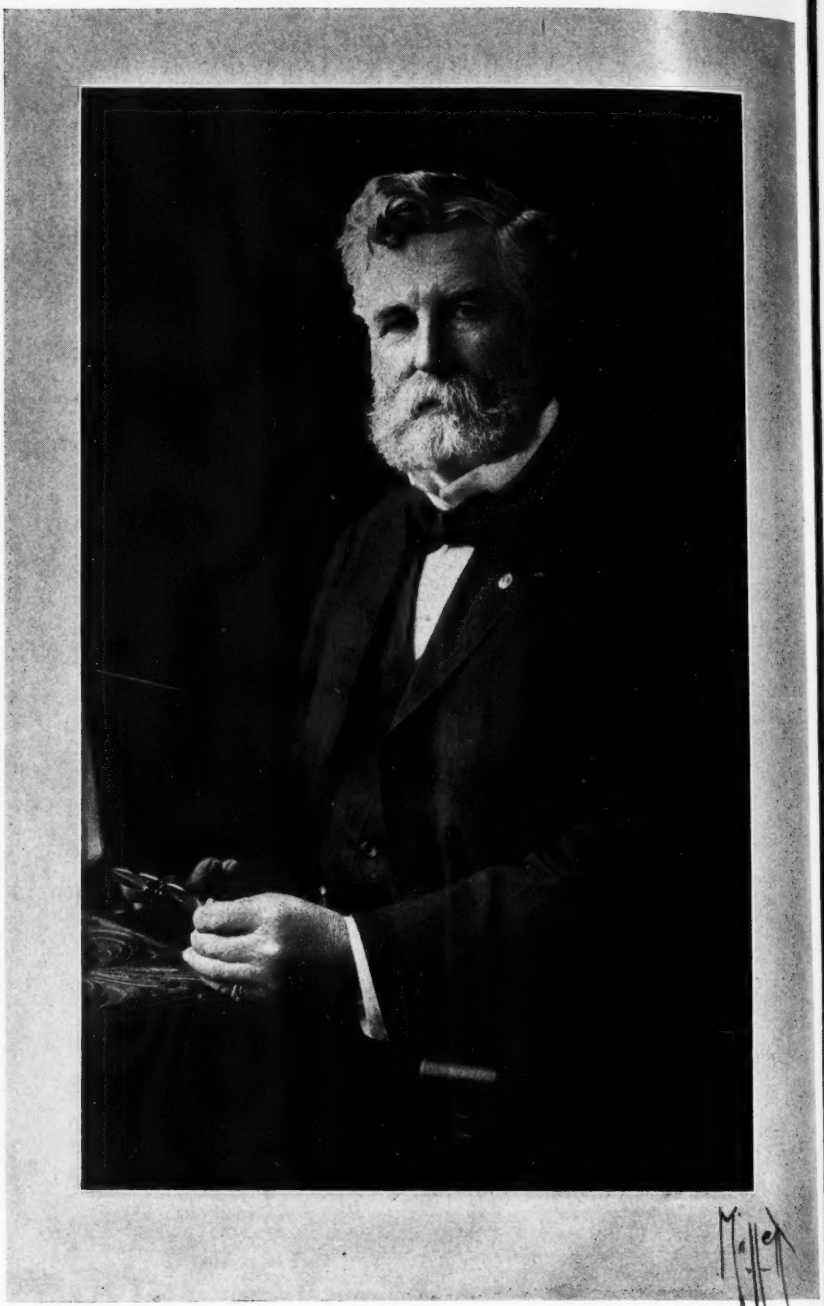

DR. TRUMAN W. BROPHY, Chicago, Illinois
President, Fédération Dentaire Internationale

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VOL. 13 JULY, 1926 No. 7

Original Communications

AN ANALYSIS OF THE "SPHERICAL THEORY" AND COMPARISON WITH "CONDYLAR ADJUSTMENT" AS APPLIED TO OCCLUSION*

By W. H. WRIGHT, D.D.S., Pittsburgh, Pennsylvania

EVERY dentist should be interested in the fundamentals of occlusion if for no other reason than as an aid in the diagnosis and correction of some of the dental disorders to which this "decaying tooth" age is heir. Widely different opinions are advocated today by some of the leaders in the field of prosthesis, and these opinions I propose to subject to investigation in the light of our present accepted knowledge of the subject.

I offer at the outset a definition of occlusion which I trust will be an aid in understanding what I have in mind when the word occlusion is used. There are two main types of occlusion: ordinary, or harmonious occlusion, and malocclusion, or inharmonious occlusion.

Ordinary occlusion is harmonious relationship of the necessary opposing tooth cusps, with or without stress, for the purpose of their efficient functioning, within the limits of necessary jaw movements, made possible by the coordination of all factors of the masticatory apparatus.

Malocclusion is inharmonious relationship of the necessary opposing tooth cusps, with or without stress, resulting in their inefficient functioning,

*This paper was originally presented in the form of a discussion of a paper by H. B. Washburn entitled "The Value of a Full Knowledge of Occlusion, When Considered from the Standpoint of Everyday Practice," which was read before the Pennsylvania State Dental Society. Dr. Washburn's paper was later read before the Massachusetts State Society and sent by that society to THE JOURNAL and published in the February, 1926 issue. It is advisable to review Dr. Washburn's article when reading the present paper. References to statements in Dr. Washburn's paper, indicated by quotation marks, are followed by the page number of THE JOURNAL.

within the limits of necessary jaw movements, caused by lack of coordination of some or all of the factors of the masticatory apparatus.

A review of the works of many of our investigators discloses an abundance of material that is helpful in understanding this problem. For example, the work of Dr. Alfred Gysi, of Zurich, Switzerland, in regard to jaw movements with natural teeth, stands unsurpassed today.

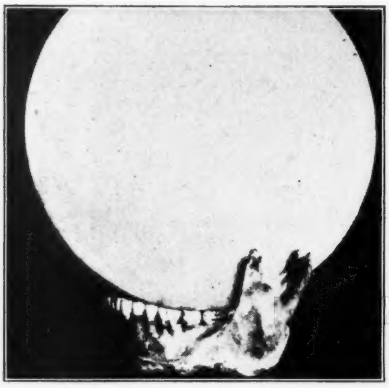

Fig. 1.—A normal mandible that does not conform to the surface of the sphere. The condyles are inside and anterior teeth outside the sphere.

Fig. 2.—Another view of the mandible shown in Figure 1. The variation of the molar teeth from the surface of the sphere may be noted.

I do not believe that, as a rule, a dentist willfully adopts any particular method or appliance in prosthesis until he has, to the utmost of his ability, been convinced that it is sound and correct. His apparent disinterestedness is due to the fact that he has not been able to master one idea until something new has appeared. The "feeling that there is nothing definite to tie to"[1] is not because the ideas are "abstract," but because we are too busy and hurried to go to the bottom of any single one and appropriate its principles in a way to make them of actual value to us.

The ultimate articulator for any case is the mouth of the individual. The restoration must eventually conform to conditions there, and regardless of how efficiently it performs on an articulator, in the final test it must function in the mouth. An articulator, therefore, is of advantage only as it is able to reproduce conditions equivalent to those in the patient's mouth.

We are called on to meet conditions as they present themselves. We cannot choose conditions. Observation teaches us that the great majority of natural teeth are satisfactory to the bearer and yet most of these possess characteristics that cannot be regarded as normal, when compared with the so-called "spherical ideal."

This observation, together with investigation, has proved that harmony of all parts of the masticatory mechanism is the ideal to be achieved in the restoration of occlusion. The spherical idea of

1. Washburn, H. B.: J.A.D.A., 13: 168 (Feb.) 1926.

harmony is insufficient. Occlusion must be adapted and suited to the conditions present in the mouth of each patient regardless of some preconceived theory, or failure will invariably result.

Dr. Monson's conception "The highest type of human occlusion to be so arranged that the occlusal surfaces of the bicuspids and molars, the incisal edges of the anterior teeth and the condyle conform to the surface of a sphere" (p. 169) has not been substantiated by investigation. Figures 1 and 2 illustrate the variations found in a great majority of human mandibles and teeth that do not conform to the surface of the sphere. From every indication, these jaws were rendering excellent service, and harmony, as we understand it, was present.

Some of the finest specimens of occlusion are far from harmonizing with the spherical "ideal." Nature never uses any device or jig to control development, and yet we find harmony of parts and efficiency in function in most cases, although there is a great variation in form.

There is, during development, so much variation in size of jaws, muscles, teeth and forces acting thereon that, ultimately, each person reaches young adult life with an individual masticatory mechanism, which *is* or *is not* harmonious. Observation proves that in most cases it is harmonious. Those that we regard as inharmonious may readily be distinguished and possibly restorations be effected that will establish harmony in the masticatory apparatus.

The spherical theory incorporates the idea of an equilateral triangular mandible of approximately 4 inches. Investigation proves this to be an untenable and unworkable premise because the vast majority of mandibles do not answer this requirement.

It is not necessary to search through an endless collection of jaws to discover the laws that control the relationship and function of the masticatory apparatus. The head of every human being and every skull possesses at least part of this mechanism, from which

Fig. 3.—Variation of incisocondylar length of mandibles when arranged on a line.

may be derived information helpful in restoring the rest.

We cannot refrain from emphasizing the fact that we are always dealing with individual cases, scarcely any of which we can reconcile with the spherical idea as proposed by its adherents.

Figure 3 shows a collection of mandibles photographed with the central incisors resting upon a line and the condyles extending, as their incisocon-

dylar distance permits, over a cord 4 inches from the incisor teeth. Figure 4 shows a similar variation in the intercondylar measurement. Such a variation in size should teach us that no spherical ideal incorporated into an articulator can accommodate this variation without injury to the mandibles; and thus explosion of the theory follows.

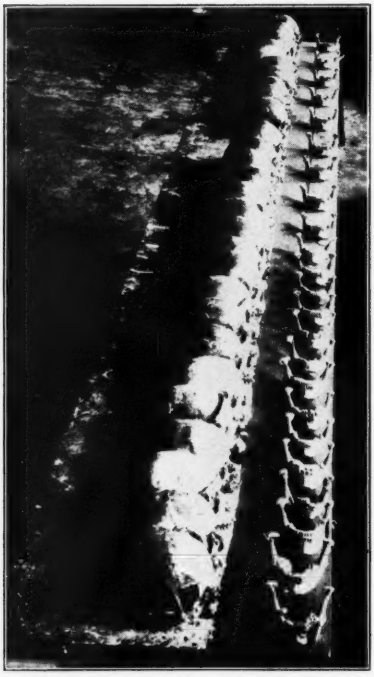

Fig. 4.—Variation in length from condyle to condyle in the mandible when arranged in line.

An examination of hundreds of skulls indicates that it would be exceedingly difficult to find one answering the requirements of the "spherical idealists," but observation of any dentulous skull will show that the teeth do, or do not, properly occlude, depending on whether they are, or are not, arranged in harmony with the adjoining or opposing ones to permit harmonious relations of the condyle, glenoid fossae and eminentia articularis during movements of the mandible. This statement will be proved later.

Anteroposterior movement on the spherical machine is executed on the compass or radial arm. Lateral movement is accomplished by rotation of the maxillary member about the radial arm. Some lateral movements are a result of both, and are influenced by the upward path of the radial arm, a condition that would not accommodate occlusions of jaws in which the condyle paths were of a greater or lesser angularity than the spherical mechanism permits.

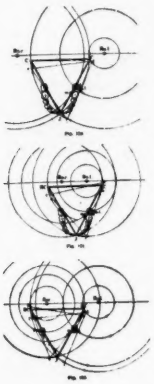

Fig. 5.—Gysi records of variable rotation centers.

Investigation has proved that lateral movements of the human mandible may be represented by the acceptance of two general axes of rotation, one for each lateral movement. These centers vary with the individual, and may be determined by mandibular registrations. Movements about these axes must not

be influenced by a directional guide not acceptable to the individual or equivalent to the condyle path angularity present.

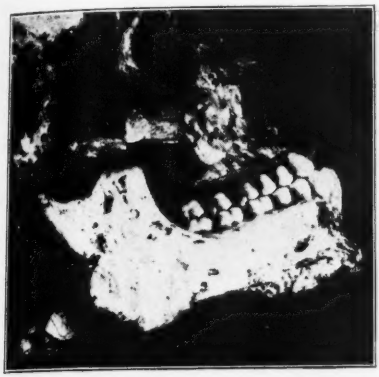

Fig. 6.—Contact of teeth in the right working position while the teeth on the left are as shown in Figure 7.

This precludes the acceptance of the fixed guidance of the radial arm on the spherical machine.

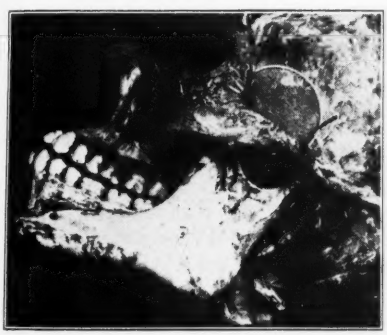

Fig. 7.—Contact of cusps of the second and third molar in left balancing position.

The importance of these movements is understood if we realize that they permit harmonious relationship and function of the cusps of the teeth in lateral occlusions, both in working and in balancing positions.

Drawings from Dr. Gysi's work reproduced in Figure 5 illustrate two rotation centers.

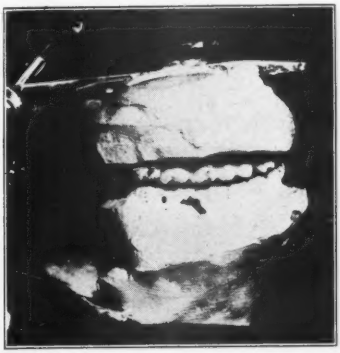

Fig. 8.—Lack of contact of teeth on the right side when casts are in the left working position as shown in Figure 9.

The geometric formation assumed to exist with the spherical theory is nearly met in the skull shown in Figures 6 and

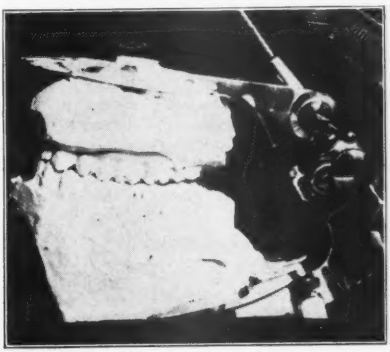

Fig. 9.—Casts of skull shown in Figures 6 and 7 mounted on Monson articulator according to requirements, showing the left working side.

7. The right working and left balancing positions are photographed to show the relations of cusps. Photographs of the opposite side show an

equally harmonious relation. Lack of space prohibits their use.

Casts of the teeth of this skull were made and mounted in the spherical instrument, where it is observed that there was no contact on the right balancing side when in left lateral occlusion. These views are shown in Figures 8 and 9.

Although this mandible conforms closely in geometric design to the

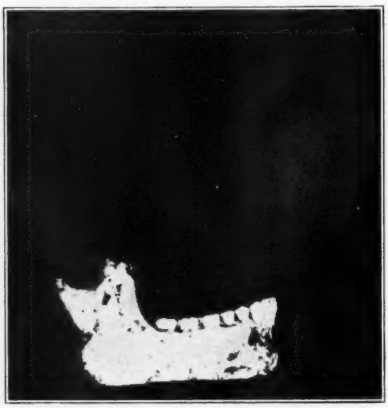

Fig. 10.—The mandible shown in Figures 6 and 7, which conforms closely to the requirement of the spherical theory.

standard of the spherical theory (Fig. 10), it should be noted that, in function, it does not travel the path demanded by this theory. The condyle incline path traveled by the jaw is less steep than that traveled by the instrument, and, consequently, the casts lose contact in the posterior region. To maintain contact, the teeth would have to be arranged on a different arc.

It has been demonstrated that, in many jaws, during function, the working side of the jaw in the molar and condyle region moves outward, thus providing additional necessary lateral movement to oppose the cusps on the balancing side.

Figure 11 shows a graphic record of a magnified lateral condyle movement. This lateral movement is lacking in the spherical machine, which is incapable of reproducing jaw movements as required by different individuals.

It is maintained by those who endorse the spherical theory that, after a dentition approximating their ideal is found "tooth contact of all the teeth will be maintained in all the masticating ranges" (pp. 170-171). This statement is not substantiated by our investigations.

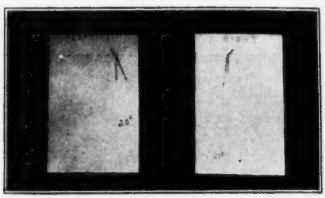

Fig. 11.—Graphic record of patient's jaw, showing paths followed by both condyles in incisive and lateral movements. Variation on each side may be noted.

The skull shown in Figure 7, which most nearly answers the requirements of the spherical theory, lacks contact of all except the second and third molars on the balancing side; which does not destroy our idea of balanced occlusion.

In order for natural teeth to conform to the requirements of the spherical mechanism, it would be necessary that they have peculiar cusps, and overbite of a character which, I fear, those who follow the spherical theory would be loathe to accept.

We question the statement that "the farther removed the occlusion is from conforming to an arc plate, the fewer the number of teeth in contact in any position after leaving central occlusion"

(p. 171). The statement, if applied to the patient's jaws, will not hold good.

Those favoring the spherical ideal maintain that "there are certain adjustments on the instrument that permit the mounting of any type of occlusion that we may come in contact with even though it varies greatly from the ideal" (p. 171). In reality, such adjustments are most convincing evidence against the spherical theory. After a given case is mounted on the spherical machine, and it is observed that the teeth do not occlude in lateral positions, adjustments are necessary.

By manipulation of set screws on the mandibular mounting plate, the lower cast is raised or lowered, which changes its relation to the spherical center in which it was carefully mounted. Since during the mounting of this cast, both the anterior teeth and the condyles were made to conform to the surface of the sphere by the use of the face bow and compass; it is now evident that the raised or lowered portion is either inside or outside the sphere. This manipulation necessitates remounting, by which the upper cast is thrown out of the spherical center. Frequent remounting may be necessary. The machine must function about its spherical center, but the teeth of the casts do not now conform to the surface of the sphere. In other words, the jaw does not conform to the ideal jaw selected as a norm; nevertheless, we are assured that restorations made according to the spherical ideal are satisfactory in such cases. This is indeed convincing evidence against the spherical theory. If the ideal foundation is lacking, an ideal restoration cannot be obtained thereon.

Dr. Monson, the designer of this spherical instrument, has admitted that this adjustment is equivalent to condyle adjustment. This proves that, although the spherical theory presents an attractive surmise, it does not explain the phenomenon of occlusion. It is therefore necessary to augment the theory with an adjustment, which is assumed to be analogous to condylar adjustment. Dr. Monson's admission proves that the truly spherical instrument is inadequate to meet individual requirements and that

Fig. 12.—Skull possessing harmonious dentition, which, according to the abrasion present, must have functioned quite efficiently during life.

it has to be equipped with a device capable of imitating condyle adjustment. It follows that whatever of merit the combination possesses is due to the incorporation of the adjustment device and not to the spherical theory. This forces the conclusion that the pseudo-condyle adjustment meets individual requirements better than the spherical theory with which it is combined. An honest investigation therefore emphasizes the importance of true condyle adjustment and discredits the

claims of those who support the spherical theory.

Figure 12 shows a skull in which harmonious relationship exists in the masticatory apparatus.

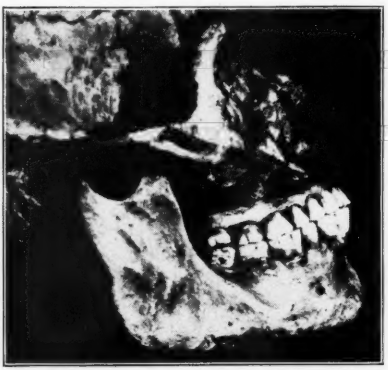

Fig. 13.—The relation of the cusps, shown in the right working position.

Figures 13 and 14 demonstrate the relationship of cusps in the right working and left balancing position, in which we see extensive contact on the working side and contact between the second and third molars on the balancing side. The cusps in the left working position and the right balancing position have a similarly harmonious relationship. In Figure 15, the mandible of this skull is shown mounted on the spherical instrument together with a cast of the upper teeth. Figure 16 shows the relation of cusps in the

Fig. 14.—The contact of the molars, shown on the left balancing side. The mandible is in the position shown in Figure 13.

Fig. 15.—Mandible mounted on spherical instrument with cast of upper teeth.

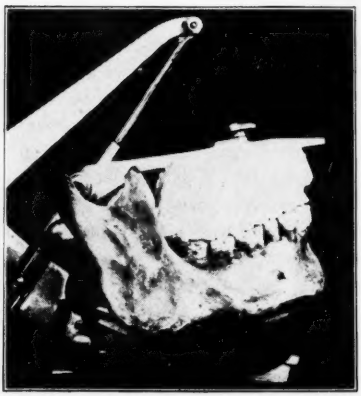

Fig. 16.—Cusps in right working position (counterpart of Figure 13).

right working position after a cast of the upper teeth and mandible of the skull, shown in Figure 13, was mounted on the spherical machine. The position is a counterpart of that shown in Figure 13. Figure 17, which shows the left balancing side, a counterpart of that shown in Figure 14, reveals lack of contact. Figure 18 shows the relationship of these cusps after the machine has been adjusted according to the spherical technic. Figure 19 presents a near view of the central occlusion before adjustment of the machine. Figure 20 shows the central relation after adjustment. Occlusal contact is lacking and remounting of the upper cast is necessary to restore central occlusion. After the upper cast was remounted, the molars still lacked contact when in

Fig. 17.—Lack of contact of cusps on left balancing side (counterpart of Figure 14).

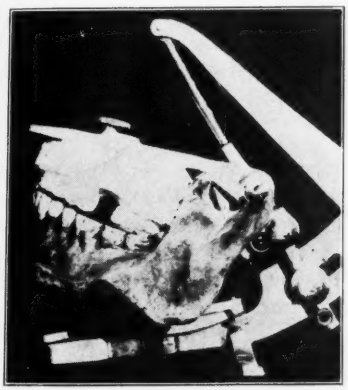

Fig. 18.—Relationship of cusps after certain adjustments were made.

Fig. 19.—View of central occlusion before adjustment.

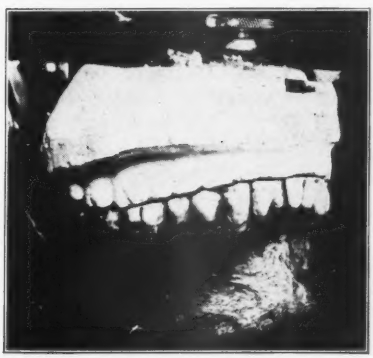

Fig. 20.—View of central relation after adjustment; central occlusion destroyed.

lateral position. Casts of both upper and lower teeth were now mounted on the articulator, and the discrepancies that were observed with the mounted mandible were present. Adjustment and remounting did not eliminate the discrepancies. Photographs showing the procedure are omitted on account of lack of space.

Referring to the statements (p. 172) that "the purpose of this group was, and still is, to search diligently for the truth concerning occlusion and mandibular movement;" also "neither Dr. Monson nor the Monson Club desires to make public any observation without first being certain of its soundness, truth and accuracy," it appears impossible that the principle of condyle adjustment could have been overlooked by men so diligently searching for truth. We conclude, therefore, that some other consideration has prevented the acceptance of this principle, which is universally accepted by other diligent searchers for truth.

A brief review of the facts substantiating the importance of the condyle as applied to occlusion is herewith presented.

Occlusion may be satisfactorily understood by a study of the component parts of the masticatory apparatus. A pretty theory is not required to explain occlusion. Nature will reveal to the earnest student that she works with the material and forces at hand and always does the best thing possible under prevailing conditions. If one succeeds in grasping the anatomic and physiologic facts of occlusion, he will possess one of the most valuable assets in restorative dentistry. He will then understand how Nature functions, and be enabled to analyze individual conditions after some of the fundamental requirements have been presented.

Normal human teeth are capable of performing the act of mastication provided they are developed in harmony with the other parts of the masticatory mechanism. Teeth must be held by the pericemental membrane and alveolar structures to the jaw bones, which are developed proportionately to the demands in each particular mouth. The teeth are arranged in two separate arches, the maxillary and mandibular, and in order that food may be masticated, these arches must be separated. This involves movement, not only of the teeth, but also of the supporting structures of the teeth. Nature has provided this movement in man by having the lower jaw movable, while the upper jaw is integral with the rest of the skull. In addition to having an opening and closing movement (lowering and raising), the mandible must have a bilateral movement (to the right, and left), and, finally, a forward or incisive movement.

The teeth, jaws and joints develop in response to stimuli present, and this development is usually harmonious. There are cases, in which the final result is inharmonious.

Each component of the mechanism has been specialized to perform its particular function: the teeth, by their hard enameled surfaces, to cut and grind the food; the jaw bones, by their strength and form, to maintain the teeth in the proper relationship, with the aid of the pericemental membranes; and the joints, with their condyles, fossae and cartilages, to serve as guiding surfaces for movements of the lower jaw.

Let us examine these structures as a whole so that we may understand their correlation. The glenoid fossae and articulator eminences are attached by

bone to the maxillae and indirectly to the upper teeth. They thereby become remote fragments of the occlusal surfaces of the upper teeth. This composite of fossae, eminentia and teeth we shall call the maxillary element of occlusion. Since the floor of the fossae and eminentia are not covered with enamel, they cannot be expected to withstand stress which the teeth themselves were designed to bear. They are guiding and restraining surfaces for the head of the condyle during motion.

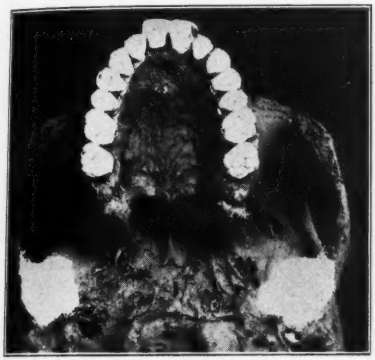

Fig. 21.—Base of skull showing teeth and glenoid fossa forming the maxillary element.

Figure 21 illustrates the maxillary element of occlusion. Since the condyles are attached to the mandible and, through bone, to the lower teeth, they thereby become remote fragments of the occlusal surfaces of the lower teeth, influencing and partly controlling the movement of the mandible. This arrangement may be termed the mandibular element of occlusion. (Figure 22). We know that since the condyles are not covered with enamel, Nature never intended them to withstand the burden of stress intended for the teeth.

We have now resolved the osseous structures of the masticatory apparatus into two main elements, and we thereby discover that, although a direct and important relationship between the upper and lower teeth should exist, the relationship between the condyles and fossae is equally important. When the lower teeth move, the whole mandible moves; therefore, it is highly important that the movement of the opposing masticatory surfaces be harmonious with the movement of the articulator surfaces of the condyles and the fossae.

Fig. 22.—Mandible showing teeth and condyles forming mandibular element.

The occlusal surfaces of the upper and lower teeth, when normally arranged, form large arches, capable of supporting the jaws in balanced relationship in central occlusion. In this position, it will be noticed that the condyles and floor of the glenoid fossae do not come in contact. These spaces provide for the interarticular fibrocartilages or menisci. In movement, to the right, left and forward, as a rule at least three points, one between the anterior teeth and one each in the right and left molar regions, should remain

in contact. It should be understood that, although the condyles move forward with the mandible, they remain in

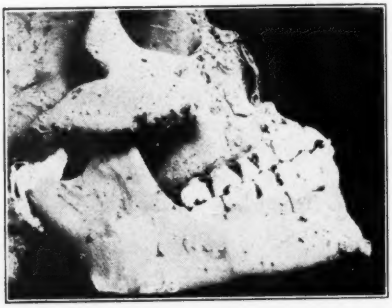

Fig. 23.—Skull showing teeth and condyle in right working position.

definite relationship with the articular eminences. The menisci move forward with the head of the condyles. From this, it will be seen that the occlusal surfaces of the teeth in contact should be harmonious throughout the range of occlusion and, at the same time, the condyles must maintain harmonious juxtaposition to the fossae or articular eminences. The skull shown in Figure

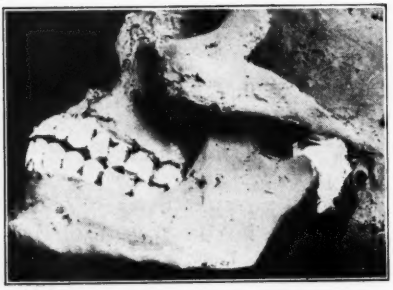

Fig. 24.—Skull showing teeth and condyle in left balancing position.

23 demonstrates the right working position, and that in Figure 24, the left balancing position. Attention is directed to the harmonious relationship existing between the maxillary and mandibular elements of occlusion. Figures 25 and 26 reveal this same harmony in left working and right balancing positions.

I have seen skulls in which the balance of the molar teeth was lost during the forward movement of the mandible. This would indicate that the curve of Spee is not harmonious with the condyle incline path; that the overbite of the anterior teeth is too great, or that some other factor lacks harmony.

We are inclined to regard these cases as abnormal, but, owing to the fact

Fig. 25.—Skull showing teeth and condyle in left working position.

that the condyle moves so rapidly from incisive to central occlusion, they seem to withstand this abnormal stress placed upon them. Normally, food is crushed between the opposing posterior teeth, which return to balanced relation either before or simultaneously with the crushing of food. The frequent return of the mandible to balanced central occlusion in these cases prevents, to some extent, a change of the structures of the temporomandibular joint. After the central occlusal balance of such cases has been lost, a great change may be noticed in the condyle region.

From extensive observation, it has been discovered that the best and longest

service, with the minimum of change in form (barring accidents), will be found in natural dentitions in which harmony exists. Whenever the relationship of parts is inharmonious, Nature will at once begin to adjust conditions so as to make the best use of them.

Space does not permit a discussion of the minute anatomy of the associated parts, but both this science and physiology prove the importance of harmonious relationship between the teeth and temporomandibular joint. One cannot fail to be impressed with the fact that the condyles were developed in this location remote from the teeth for the express purpose of influencing the lower jaw during the mastication of food. The condyles surrounded by muscles and ligaments become important factors in guiding and controlling the movements of the lower jaw. The condyles are placed in the most favorable geometric location to function properly.

Figure 27 shows a mandible on the teeth of which is superimposed a protractor and slide rule determining approximately the angularity of the path of the left condyle to the occlusal plane of the teeth. The condyle path was determined by reestablishing function on the skull with softened compound, interposed between the head of the condyle and the eminentia articularis.

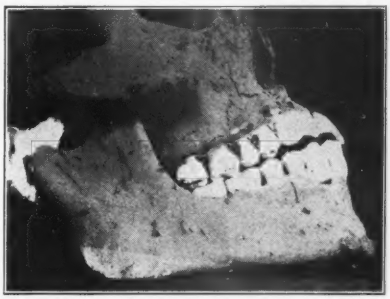

Fig. 26.—Skull showing teeth and condyle in right balancing position.

Figure 28 shows the same mandible on an articulator capable of condyle adjustment, demonstrating the relationship of the condyle path of the mandible to the condyle adjustment of the machine.

Figure 29 carries this demonstration a little further, showing casts of this skull mounted on the articulator, when, by adjustment of the condyle guidance

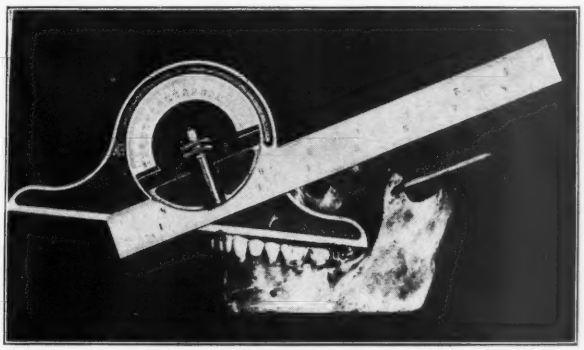

Fig. 27.—Mandible showing protractor and slide rule in position.

to the proper position, it is apparent that the cusps of the second and third molars make contact in the left balancing

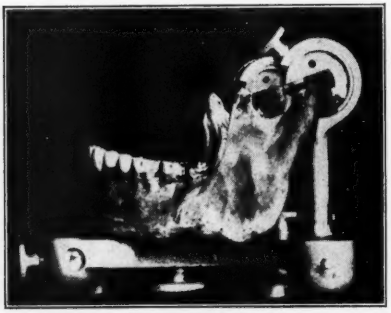

Fig. 28.—Mandible shown in Figure 27, on the articulator with condyle guidance adjusted.

position. These casts, which are the ones that were mounted on the spherical theory machine (Fig. 17), showed lack of contact of the cusps in this position. Figures 30, 31 and 32 show the same equipment on the right side, the condyle path of which has been determined as explained in Figures 27 and 28. It will be noticed that cusps of the second and third molars are touching. In Figure 33, a skull has been mounted upon the instrument in central occlusion and the condyle guidances of the machine have been adjusted to an equivalent position

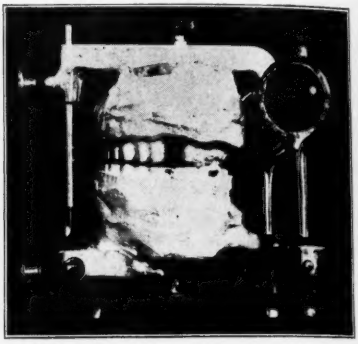

Fig. 29.—Casts of mandible shown in Figures 27-28, on the articulator with condyle adjusted.

which will produce harmonious functioning of the teeth and condyles. Figure 34 presents the same skull with the teeth in the right balancing position. Figure 35 shows the contact of the teeth in the left working position. This simple demonstration will show the condyle path harmonious with the teeth, and vice versa.

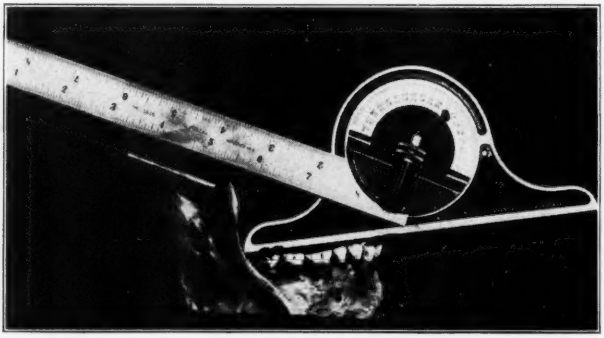

Fig. 30.—Mandible (Figs. 27-29) right side, with protractor adjusted.

Let us now consider full denture

work. When full dentures are placed in the patient's mouth, they gradually intrude or settle into the tissue, owing to displacement of the mucosa and resorption of the residual ridge. Even before resorption occurs, but especially afterwards, the condyles rest more heavily upon the articular eminences and the floor of the fossa than when the natural teeth were in ordinary occlusion. Abnormal pressure will be applied at the condyles during mastication regardless of how well dentures are balanced.

It is evident that, since dentures move on the tissues, they are incapable of fully supporting the mandible or the condyles in as rigid harmonious relationship as when the natural normal teeth are present. Since it is impossible to prevent the condyles from resting too heavily on the floor of the fossae when dentures are worn, it becomes highly important that the direction followed by the dentures during function be harmonious with that demanded by the relationship of the condyles to the fossae.

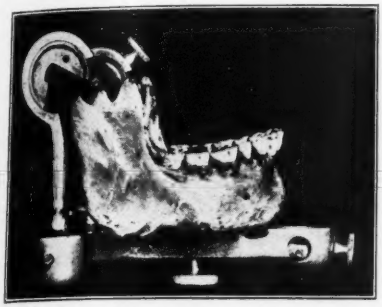

Fig. 31.—Left view of mandible (Figs. 27-30) on the machine, showing condyle guidance.

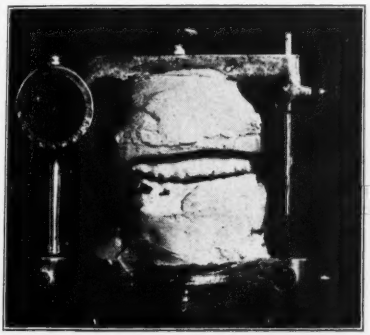

Fig. 32.—Casts of mandible (27-31) showing condyle guidance adjustment of the articulator and occlusal contact of the balancing cusps.

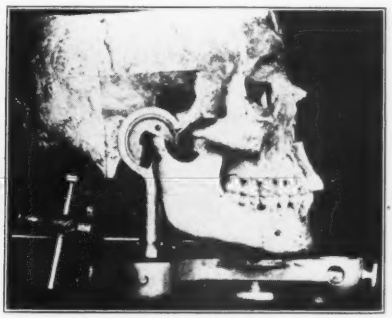

Fig. 33.—Skull mounted on the articulator.

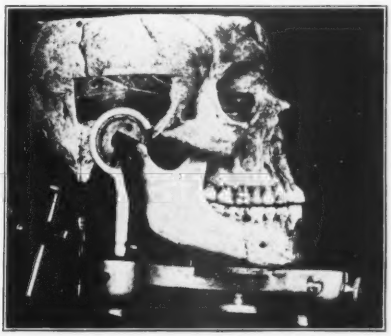

Fig. 34.—Right balancing occlusion.

Otherwise, we will discover that the condyle must influence the direction of movement of the dentures until the functional relationships are rendered more tolerable than they formerly were by resorption of the residual ridges and alteration of the condyle.

If the condyles receive too much pressure even when artificial teeth are arranged harmoniously to accommodate them, will they not be compelled to bear an additional burden when the teeth are arranged inharmoniously? In reality, the condyles do not withstand this additional burden, for, in a short time, their surfaces, together with the fibrocartilages or fossae, are altered by abrasion in an attempt to work in harmony with the movement of the artificial dentures.[2]

With the foregoing facts in mind, let us now consider the subject of restoration.

Dr. Washburn has suggested, in his illustration of the gear, that when "a certain section of the periphery of the large gear has been broken out" it could be reestablished by the "machinist." (P. 171.) This illustration appears quite illogical, especially since the human body is not made up of gears; neither is it possible to remove, repair and replace important functional structures of the human body. In fact, after an organ or structure has been allowed to become damaged, it becomes the duty of the physician or surgeon, by treatment or operation, to restore the diseased or injured structure to the best possible state of health.

It still remains impossible for science to replace the defective valves of the heart, even though a machinist may replace a valve in a pump. The individual possessing this type of heart must take its defect into consideration and thereafter harmonize his living with it. As yet, it is impossible for science to replace a limb except by an artificial one. The individual so unfortunate as to lose a foot is compelled to use some form of support for the rest of his body, and I have never yet seen a case in which the use of support has influenced the development of a new foot.

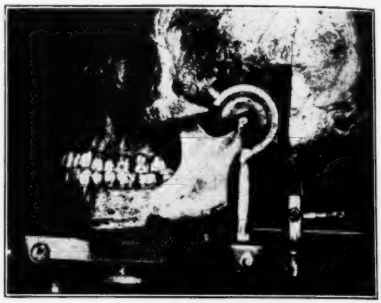

Fig. 35.—Left working occlusion.

The same principle applies in full denture restorations. We are unable to replace lost organs (teeth) except in very rare cases with others that are as efficient as the normal natural teeth. Yet, we, as dentists, must be content with this result, which is not ideal, and expect our patients also to be content. We know that, after it has been damaged, the temporomandibular joint will not return to normal, especially if the patient is edentulous. If restorations supported by natural teeth were placed in the mouth to harmonize with existing conditions, it is possible that the retrograde change would not continue. We cannot expect to do more with full denture restorations than to accommo-

2. Wright, W. H.: Some Observations of Jaw Relationship to be Considered During Full Denture Construction, J.A.D.A., 9: 209 (March) 1922.

date existing conditions and delay retrograde change.

Science has not been able to open the temporomandibular joint; place a new head on the condyle, or add an eminentia to the fossa. Until such restorations are possible, it will be necessary for us to restore cases in harmony with conditions as they exist, and thereby prevent further change and induce more comfortable function.

Referring again to the illustration of the gear: It is true that there is a possibility of the mechanic reestablishing the periphery of his gear, but it is impossible for the dentist by such drastic means as are advocated by the adherents of the spherical theory to restore the condyle conditions of his patient.

We agree that anyone who attempts restoration should have in mind the ideal or typical conditions found in the mouth. We should like to discover, however, what law in Nature demands that, when a cast is mounted on the spherical machine the teeth should be harmonious with the surface of a sphere, especially since neither the jaws, the teeth or the condyles conform to the ideal of the spherical theory. If this is a demand of Nature, we would like to know how the patient's spherical center is accurately located and utilized. It appears to us that those who follow the spherical theory use every effort to arrange the casts by remounting and adjustment so that they will conform to the machine and not to the patient. The spherical theory is exceedingly empiric.

It is not necessary, after a cast has once been mounted with the face bow and is in central jaw relationship on an articulator employing condylar adjustment, to disturb a central relation mounting in order to accomplish certain contact relations, as suggested by Dr. Washburn.

I object to a comparison of other vocations, which are not analogous, with dentistry. Let us briefly analyze the four comparisons suggested by Dr. Washburn (page 173). "In this respect dentistry must have standards such as we find in medicine, law, theology and engineering."

We admit that standards are necessary, but we cannot concede that they can be applied literally to an individual by any profession. "Medicine and surgery demand a knowledge of the healthy, perfectly formed body, as the standard by which unhealthy, deformed bodies are recognized." This statement is correct. Does this standard insure individuals against accident and the necessity of wearing artificial limbs, glass eyes, artificial noses, ears or dentures? All of these artificial restorations, when required, must be made to fit the individual who needs them, regardless of the standards which apply to humanity as a whole. Just as these restorations are not standard in form, in order to meet individual requirements, they are also substandard in efficiency.

"Law has well established statutes and precedents;" but, may we ask, do these laws apply to restorations of the human body? Does law prevent individual transgression? Does theology prevent sinning? Regardless of perfect statutes and sublime theological truths for standards, we must still contend with individual conditions, and it is questionable whether any individual is capable of fully measuring up to either of these standards.

Engineering affords an interesting although not an analogous comparison. A building engineer is called in to remodel

an old building. We assume, for purposes of comparison, that the old foundation and walls cannot be replaced (just as the ridges, condyles, etc., cannot be replaced in the human skull). The engineer would like to construct an ideal modern building, but, under the present circumstances, he is compelled to compromise. He therefore restores the interior in keeping with engineering principles, but it is not possible to attain the ideal standard because he was compelled to accommodate his restoration to the old condition present. We believe that these comparisons more nearly represent dental conditions.

In regard to the three points that Dr. Washburn suggests, the search for a standard or norm is a justifiable undertaking. However, when this standard is expressed in metal and an attempt is made to conform all cases to this standard, it then becomes detrimental to the best interests of the patient, as we have shown.

The accepance of an ideal cannot be forced, except when the aggressive force is greater than the one coerced, and then, as soon as the restraint is removed, former conditions return, unless, by desire or habit, it is easier to retain the new than to revert to the old.

Dr. Washburn asks: "Would you expect a surgeon to recognize a deformity in the human body without first having a full understanding of the body in perfect health?" (P. 174.) It depends on what, and where, the deformity is. Even patients without any knowledge of anatomy are able to give us complete information relative to deformities, especially conditions of malocclusion which, we as dentists, are frequently called on to correct.

Dr. Washburn says (p. 174): "To be balanced according to our conception of balanced occlusion, there must be equal occlusal contact on the side which we cannot see as on this exposed side;" also "there will be a maximum contact at all times."

A study of anatomy teaches that there are a few less cusps in contact on the balancing side than on the working side, contact, in many cases, in balancing lateral occlusion, being limited to the superior lingual and inferior buccal cusps of one, two or three molars.

We agree with Dr. Washburn that "such types of cases" demanded by the spherical ideal "are very rare" (p. 174).

We desire to be classified with the group of dentists who are of the opinion that there is a possibility of jaw deformity and mutilated occlusion accompanied by various changes that Dr. Washburn has mentioned. Being familiar with skulls representing the highest anatomic types in Nature and appreciating the requirements of a restoration in the mouth, we still contend that there is a limit to the application of an ideal to an individual restoration. This limit is determined by the conditions present.

From this study of the subject, you will realize that the greatest task before us as a profession, relative to the subject of occlusion, is the maintenance of each factor of the individual masticatory mechanism in its most harmonious condition for functional efficiency.

Primarily our task is prevention, rather than cure; secondarily, restoration of functional efficiency. If inharmonious relations are prevented, it will be unnecessary for us to compromise abnormal conditions in our reconstruction work. The dentist who arbitrarily accepts and establishes a restoration within the masticatory apparatus, taking into consideration the

anterior or denture bearing areas of the maxilla and mandible, but who ignores the truly scientific reasons and methods for taking care of the posterior parts (the condyle and fossae) is not making use of the fullest knowledge in these matters.

The analysis presented leads to the conclusion that the "spherical theory" is fallacious. The title of the paper by Dr. Washburn is misleading, since, as we have shown, he does not attempt an explanation of occlusion in keeping with anatomic and physiologic facts.

SUMMARY

The "spherical theory" is here rejected, because:

1. The highest type of human occlusion does not conform to the "spherical ideal."
2. Equilateral triangular mandibles answering the requirements of the spherical theory are very rare or entirely lacking.
3. Anteroposterior movement on the spherical machine is influenced by a fixed predetermined guide, incapable of accommodating individual requirement.
4. Some lateral movements are affected by the same fixed guide.
5. Casts of the teeth of skulls closely conforming in geometric design to the spherical theory requirements may not meet functional requirements of the spherical machine.
6. No lateral condyle movement is possible on the working side of the spherical instrument.
7. Tooth contact as required by the spherical theory is not found in Nature.
8. The spherical theory demands tooth forms not found in Nature.
9. Certain adjustments prove that the theory is insufficient.
10. Remountings that are necessary after adjustments are not at all scientific.

Condylar adjustment is accepted because:

1. Each skull presents individual conditions due to developmental influences.
2. The laws applying to function of the masticatory apparatus may be studied in any normal skull. It is not necessary to search for a "spherical ideal."
3. Because the principle of condyle adjustment is fundamental, it is imitated by certain adjustments of the spherical machine.
4. It will accommodate conditions present, whether normal or abnormal.
5. Most jaws, teeth and condyles function harmoniously in accordance with Nature's laws.
6. A properly constructed condylar adjustment machine is capable of reproducing relations equivalent to those demanded by individual requirement.
7. Full dentures function under conditions absolutely different from those present with natural teeth and therefore demand individual compensation for these variations.
8. Anatomic temporomandibular structures once seriously impaired do not regain their former integrity.
9. It is unnecessary to remount to compensate individual requirements after a cast has been mounted by use of the face bow in central relation on a condylar adjustment machine.
10. It is difficult to force acceptance of an ideal on any profession. This is especially true with dental restorations which do not harmonize with individual requirements.

GOLD FOIL—ITS APPLICATION TO PROXIMAL CAVITIES OF THE UPPER ANTERIOR TEETH*

By FRANK D. BURNS, D.D.S., Denver, Colorado

GOLD foil for filling teeth has had its ups and downs in modern dentistry, but it always comes back as an old friend that produces results. There has always been and always will be a large percentage of men using gold foil, especially those who want to do the best dentistry for their patients. Unfortunately, there are many who have never learned to work gold, and these men are generally making poor inlays and worse synthetic cement fillings, thus lowering the standard of dentistry; which is clearly reflected in every branch of the science.

C. N. Johnson has said,[1] "Given two men starting out with equal ability, and let one practice extensively the insertion of gold foil, and the other practice without it, and in ten years time the former will be an infinitely better operator than the latter. He will have ability in his fingers to do a higher class of work and do it easier."

J. V. Conzett has said,[2] "I told those dentists who were abandoning the use of gold foil that just as sure as two and two are four they would deteriorate in their technical ability if they ceased to use gold."

Dentists are human beings and as such are always looking for something easy—that's why we have "bunco men;" and I fear some of them are in our profession, since many have correct judgment, but bunco the patient because they want something "easy."

Since the advent of the cast gold inlay, gold foil the greatest of all tooth savers when properly handled, has by many men, for various reasons, been relegated to a secondary place or entirely discarded as a filling material, when good sound judgment and the dictates of their own conscience must tell them that gold foil is the filling indicated in many cases. For any dentist to admit that he cannot master gold foil is to admit that he is not master of himself. A difficult task well done is a joy to any live human being, and will make other difficulties met in practice and every day life much easier to overcome.

Porcelain was expected to supplant gold, but we now know its limitations. Then the cast gold inlay came along, and we were told to throw away our pluggers, because it was to bring the utopia for which dentists were seeking, and a very good filling material for many cases it has proved to be, when the exacting technic is properly carried through; but observation proves that the man who does not make good

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Sixty-Seventh Annual Session of the American Dental Association, Louisville, Ky., Sept. 23, 1925.

1. Johnson, C. N.: Dent. Rev., 23: 338 (April) 1909.

2. Conzett, J. V.: Dent. Rev., 23: 351 (April) 1909.

gold foil fillings nearly always makes poor inlays.

In recent years, the silicious cements have come to the fore. These are nothing more or less than a high grade cement having few or no adhesive properties, and they are the most worthless of all filling materials to be classed as permanent. For the class of cavities with which this paper has to deal, they are worse than worthless. I have never seen one that has been in the mouth six months and has maintained its contact as made. As a result, the teeth are dropping together, and, if many are placed, the whole arch is a wreck in a very short time. In addition, they destroy many pulps, especially in the teeth of our younger patients. Using the old "new departure creed" brought down to present day practice: "as teeth need saving, synthetic cement or porcelain or whatever name is given it is the very worst material to use."

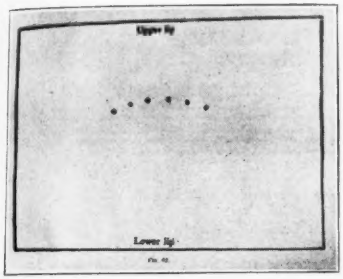

Fig. 1.—Rubber dam, approximately 5 by 6 inches, showing proper position of holes usually punched with next to the smallest size hole of the punch. (After Black.)

As the architect must see the finished structure before the first excavation is made, so the dentist must always have in mind a clear picture of his finished filling before he starts operating, making a careful study not only of the mouth but also of the general condition of the patient, noting the age, physical condition, susceptibility or immunity, position of the teeth to be operated on in the arch, occlusion, traumatism, periodontoclasia and vitality. A good radiogram should be made to show the size of the pulp, especially in our younger patients, and any conditions that will tend to make the operation enduring or destroy the finished product

Fig. 2.—Use and abuse of ligatures. Much harm of an irreparable character is done to the periodontal tissues in the application of ligatures. In the majority of cases, they are not needed at all if the teeth are properly cleaned before application of the dam and then washed with alcohol to remove the mucous coating, the operator deftly turning the edges of the dam gingivally, and when the crown of the tooth is dried after this treatment, the dam stays in place as well without a ligature as with it. For the distal edges of the dam, a knot tied in the ligature and drawn between the teeth will usually hold it from pulling past the contact point. (After Black.)

quickly should be noted. No two patients are exactly alike; neither are any two teeth; but the same general conditions prevail for all, while the technical details will differ and, unless these are taken seriously into consideration, a high percentage of failures will result.

The fundamental principles of cavity preparation as laid down by the late G. V. Black are as true and as firmly established today as when they were formulated, and they will remain so until some genius finds a filling material of the same structure and substance as

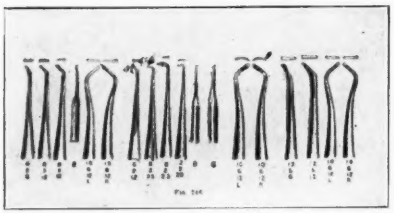

Fig. 3.—Instruments used in the preparation of cavities of class III, which will prepare every cavity of this class, large or small, with or without the lingual step or malposed in the arch. It does not make much difference what or whose instruments are used, but the operator must always cut with decision and precision; that is, decide exactly what he wishes to do and then do it precisely. Small hoes and hatchets and a No. 34 bur are used for breaking down weakened enamel, to secure the outline form. Small hatchets and hoes and Black's 3-2-28 special hatchet and No. 34 bur are used to secure retention form. The No. 33½ bur is for convenience points, the small spoons to remove the remaining carious dentin, and the larger holes and smaller enamel hatchets to finish the enamel wall. (After Black.)

the enamel that may be applied plastically and that has great adhesive qualities as regards the normal tooth structure; and until that day comes, for permanency dentists will be filling teeth with metal just as we of today are doing. This method has done more to save teeth for susceptible patients than anything that has ever been promulgated; and thanks to the gold inlay, all men were forced to use it whether they liked it or not.

In laying the outline form, which is the first form in the Black system, after studying the foregoing general con-

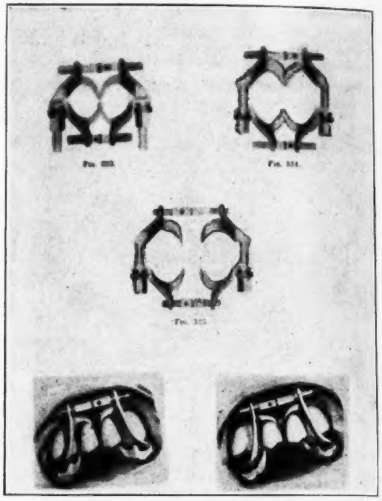

Fig. 4.—The separator used for immediate separation. It is adjustable to any position and any size tooth or interproximal space. An instrument of this or some other type must be used for this class of fillings. (After Black.)

ditions, we should have a clear picture in mind as to where the cavity margins are to be placed. The surfaces of the teeth which these fillings are to restore are triangular, with the base of the triangle at the gingival line, and this margin must be laid beneath the normal healthy gum because "decay never takes place under normal healthy gum tissue." The outline also makes for the good appearance of the filling, and these

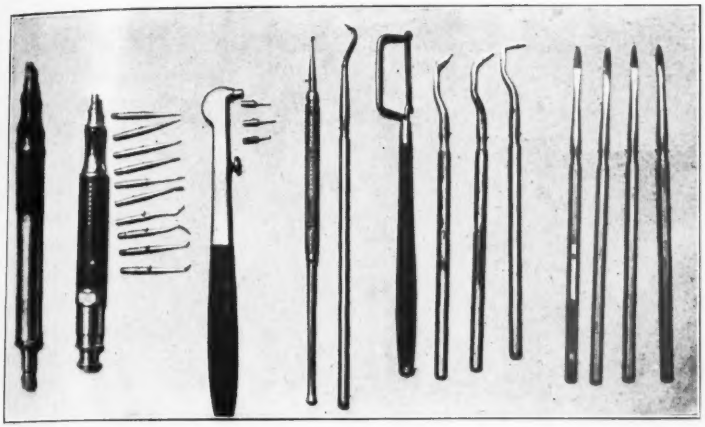

Fig. 5.—Instruments used for adapting and condensing the gold in all cavities. The first two are the regular automatic mallets. The next are the plugger points used. Then there follows the right angle automatic mallet and the plugger points used for it. Then comes the round plugger 5-3-23, for filling the incisal angle, used by hand pressure. Next is Black's holding instrument and then his separating saw and three finishing knives and four finishing files. These instruments will place and finish fillings not only in the anterior teeth, but also in all others.

cavities should be filled as soon as possible after dissolution of the cementing substance of the enamel declares their presence. The color of gold will always be conspicuous, and here is opportunity for display of artistic ability. Lovers of gold foil operations take pride in concealing their art by the highest type of art. It is not the person with the large red nose that attracts the most attention, but the one with the misshapen nose or no nose at all; so, to a large extent, it is with the gold foil filling. If it fully and perfectly restores the shape and contour of the tooth with delicately curved marginal lines and angles, and a solidly condensed surface nicely polished, although it may be large, it does not immediately attract attention, as does the one that does not preserve the contour, has sharp square angles, a poorly condensed surface and a poorer polish, because the artist has

Fig. 6.—Proximal view of two central incisors. The one on the left has the narrow cavity toward the gingival with the incorrect gingival wall; that is, not a flat seat at right angles to the length of the tooth or a curve approximately paralleling the cemento-enamel junction, which will invite caries at both the labiogingival and linguogingival angles. The one on the right shows the correct formation; that is, the flat gingival seat carried to immune areas on both labiogingival and linguogingival angles.

not concealed his art by reproducing that which was lost in exact contour and gracefulness.

In the class of cavity with which this paper has to deal, the foil is placed and adapted largely from the lingual surface, and ready access must be gained by cutting it away well past the lingual marginal ridge. This is the convenience form, and convenience in placing the filling material must be attained in the preparation of the cavity. Close observation has shown that the proximolingual angle is nearly always undermined and weakened by caries; so, by this method, we do not lose any desirable tooth structure, because if we should, thinking to be conservative,

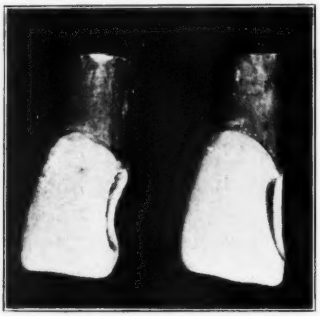

Fig. 7.—A labial view of the two teeth, in Figure 6, showing lack of extension at the labiogingival angle of the one on the left.

Fig. 9.—Beginning of caries just gingival to the contact point. The way a cavity should not be prepared, the correct preparation, and the cavity after filling, showing better the lingual extension. (After Black.)

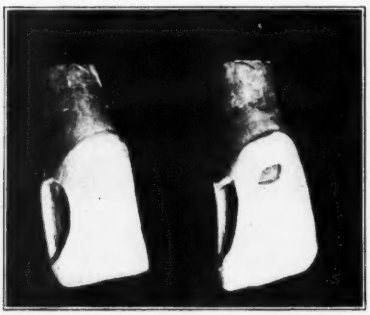

Fig. 8.—A lingual view of the teeth shown in Figures 6 and 7, with the same criticism of the one on the left; that is, lack of extension of the linguogingival angle, inviting caries in that location. The one on the right shows correct preparation and extension.

Fig. 10.—A central and a lateral incisor, showing a minimum of extension used in cavity preparation; that is, the gingival margin under the normal healthy gum, the labial just past the proximolabial angle of the tooth and the lingual far enough on the lingual surface to make it convenient to insert the filling material.

leave it, the force of mastication will soon chip it away, and, in the course of time, the filling will be lost.

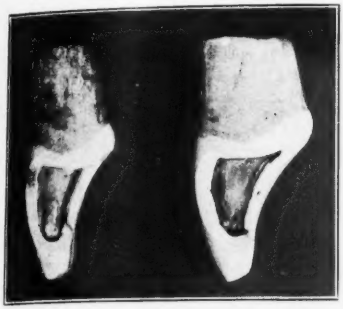

Fig. 11.—Mesial view of maximum extension that can be practiced without involving the angle of the tooth. The gingival wall parallels the cemento-enamel junction.

Dr. Black has this to say about it:[3]

In following the inclination of the enamel rods around the incisors and cuspids in the circumferential direction, we find them generally standing perpendicular to the surface at the junction of the middle and gingival

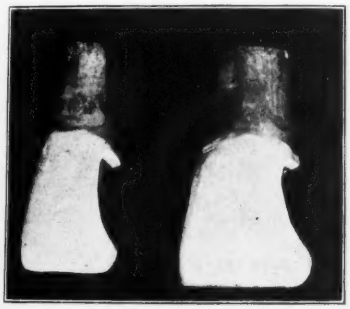

Fig. 12.—Labial view of the two teeth shown in Figure 11. These cavities, owing to extensive caries, are cut farther over on the labial surface. The delicately curved marginal line angle, which adds much to the beauty of the filling when inserted, may be noted.

3. Black, G. V.: Operative Dentistry, Ed. 1, Vol. 2, p. 99.

third of the length of the crown. A notable exception to this is the approach to and over the mesio- and disto-lingual marginal ridges. Here the enamel rods incline somewhat toward the marginal ridges, but, in passing over these ridges, their direction or inclination changes very suddenly and often very irregularly. For this reason this becomes rather a

Fig. 13.—A lingual view of the preparation shown in Figures 11 and 12. The lateral incisor on the right shows the lingual step or dovetailed anchorage, which, in many cases, saves the incisal angle of the tooth by not weakening it more than was done by actual caries. The central on the right was deemed strong enough to make the regular incisal anchorage; that is, a cut into the dentin with the 3-2-28 special hatchet.

Fig. 14.—This slide shows another type of lingual extension, not so large, but deeper, intended for those teeth in which the roentgen-ray shows the pulp to have receded so that there is a minimum danger of cutting into it.

dangerous point in the preparation of proximal cavities in the incisors. When the marginal lines of these proximal cavities reach to the lingual marginal ridge, it is rarely safe to

Fig. 15.—The distal side of the left cuspid. Commonly, this is considered the hardest location in which to place foil, but with this type of preparation and the right angle automatic mallet, it is as easy as in any other tooth in the mouth.

leave any of the ridge remaining, because of the uncertain direction of the enamel rods. Especially is this true of the lateral incisors in which the curve of the ridge is often very abrupt. While this ridge is very strong in

Fig. 16.—The labial view of the tooth shown in Figure 15. There is not enough extension to be conspicuous when the cavity is filled.

the perfect tooth, it becomes very frail when its support on either side has been destroyed and the only safe course seems to be to cut it away sufficiently to be certain of the direction of the enamel rods upon the margin formed. The rounding of the labio-mesial or labio-distal angles is not so abrupt, and the enamel

Fig. 17.—Lingual view of the tooth shown in Figure 16. It is cut away, and far enough toward the incisal so that it is very conveniently filled at a correct angle for malleting.

rods usually hold closely to a direction perpendicular to the surface, so that good margins can be made at any point by observing carefully the form of the tooth and the enamel cleavage.

The gingival wall must be at a right angle to the length of the tooth and provide a flat seat or follow the curvature of the cemento-enamel junction,

Fig. 18.—Teeth shown in Figure 17. The large model gives a better idea of the way the cavities look after being prepared. The large one on the distal side of the left central incisor is naturally the most conspicuous; while the mesial cavity on the left lateral incisor as well as the large one on the distal surface are hardly noticeable. The one on the distal surface of the left cuspid cannot be seen here.

but never in any case, as we so often see, should this wall be made with a convex surface not parallel to the gingival margin of the enamel, as we shall most certainly invite future caries at the labiogingival or linguogingival margins of the filling. The labial margin should usually be placed just labially to the marginal ridge that divides the proximal from the labial surface of the tooth, and should be gracefully curved, never straight.

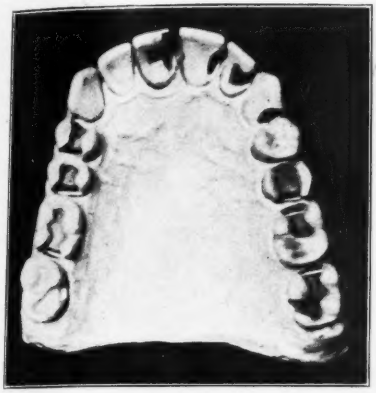

Fig. 19.—An occlusal and incisal view of the large model (Fig. 18), showing how the cavities look when viewed from that direction. The one in the mesial surface of the left central incisor as well as in the left lateral incisor will have to be filled before the large ones in the mesial surface of the right central incisor and the distal surface of the left central incisor. They are cut only to the lingual marginal ridge, enough dentin having been left by a minimum of caries so that the ridge is well supported. The convenience in the distal surface of the left cuspid may be noted.

Fig. 20.—Another view from the lingual surface showing the same general conditions, (Fig. 19). The convenience in preparation on the distal surface of the left cuspid may be noted.

If the teeth are placed irregularly in the arch, this condition must be taken into consideration and the operator governed accordingly. Thus, you will have a filling that will not be unsightly from show of gold and also will not cast a shadow and look like a cavity or unpolished filling. To do this from the labial surface requires much separation or more cutting of labial enamel plate.

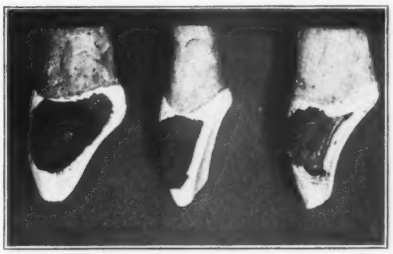

Fig. 21.—Adaptation of the foil to the cavity from the lingual approach. The one on the right shows the labiogingivoaxial and labioaxial angles filled. The center one shows an addition of the incisal angle filled while the linguogingivoaxial angle is not yet filled. At this stage it is wedged with foil, the filling thus being locked from all three angles. The cuspid on the left shows the completed filling before polishing.

The incisal margin is usually placed incisally to the contact point, except in some of those teeth in which the contact is at a place in or near the incisal angle, when it is better to land this margin far enough gingivally to leave sound dentin in which to anchor this angle of

the filling; which necessitates building the contact point in a location gingivally to the one Nature provided. Should the angle be already undermined by caries, so much so that to make the regular incisal anchorage would so weaken it that it would be liable to easy fracture, it is perfectly permissable and good practice to make a dovetailed step on the lingual surface of sufficient size to give the filling retention, thus saving the incisal

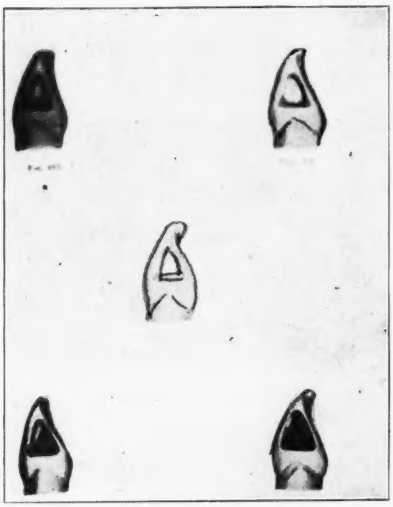

Fig. 22.—Adaptation of foil from both the labial and lingual approach, filling first the labiogingivoaxial, then the linguogingivoaxial angles and connecting the two points by filling along the gingivoaxial angle, then filling up almost entirely from the labial approach until the incisal point angle is reached, and finishing the filling by wedging against the labial wall. (After Black.) The line of force is not in line, nor does it approximate the line of force used by the patient in mastication. It necessitates more separation or greater cutting away of the labial enamel plate.

angle of the tooth by leaving all the sound dentin possible in that location.

All enamel cleavage is done with small chisels, hatchets or hoes, correct inclination being thus given to enamel rods in all parts of the cavity to provide strength for the walls and prevent future falling out of loose and short rods. The beveling of the cavosurface angle is always done as taught by Dr. Black.

Fig. 23.—A proximolabial view of the central and lateral incisors and cuspid with finished fillings.

ADAPTATION

Many men never get the idea of close adaptation of the filling material to the walls of the cavity and how to accomplish it with gold foil. The density of the filling and resistance to crushing

Fig. 24.—A proximolingual view of the central and lateral incisors and cuspid (Fig. 23), with finished fillings.

stress does not always indicate close adaptation to the cavity walls. No amount of incorrect hammering will accomplish it; while heavy malleting will make the body of gold a very dense, hard and springy mass; yet the

force of mastication may move the filling in the cavity, and the air pressure test show numerous leaks about its margins, because it is not properly adapted.

Fig. 25.—A labial view of the teeth filled, the large model showing exposure of gold and contact points. The gingivolabial extensions under the free margins of the gum tissue may be noted.

Operations of this kind are punishment to patients, and the results attained are far from satisfactory.

Gold foil, fully annealed, is capable of being forcibly adapted to the walls of a cavity, and, when so adapted, is

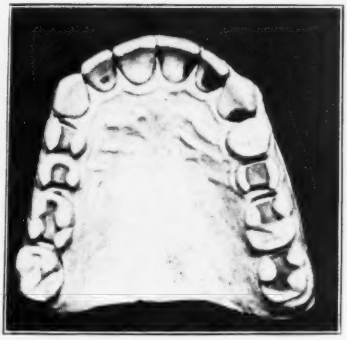

Fig. 26.—An incisal and occlusal view of the large model.

immediately capable of sustaining that forcible adaptation, as the force used in hammered gold foil is closely comparable to the force of elasticity of human dentin. Now if this is true, and it was so proved by Dr. Black, and others, it is also true that no other known filling material will serve our patients so well when properly manipulated. But, you say, that is the obstacle: it is not easy of manipulation. In reply I will say that its successful manipulation requires much study and more practice, carefully and consistently carrying through to completion every detail to the last minutiae, and when this experience and practice is obtained,

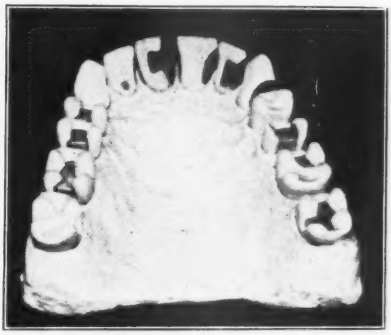

Fig. 27.—A lingual view of the fillings in the large model. The convenience form is at once shown, and gold foil is easily adapted to such cavities.

gold foil makes by far the most perfect and enduring filling possible to be inserted.

Correct adaptation and condensation is to be accomplished only by laminating the foil, regularly stepping the plugger point from the body of the filling toward the wall of the cavity to be covered, directing the force of the mallet always in the same general direction, an angle of approximately 12 centigrades, and regularly wedging the gold to the cavity walls with enough force to make a dense hard filling. In the majority of these cavities, the correct line of force can be secured

with a straight or direct action mallet, which is always preferable. The patient is placed in the chair, reclining with the head well lowered, yet so the head rest will support the head against the blows of the mallet. An easy access is thus usually to be had. In other cases, a back action plugger or

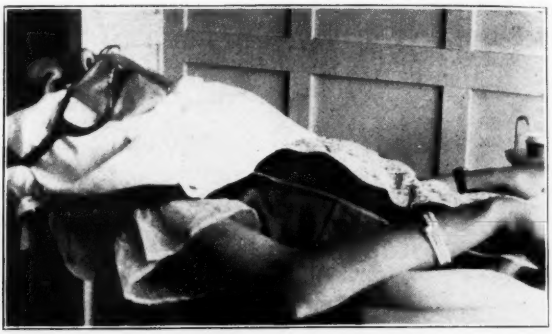

Fig. 28.—Position of patient in the chair. To recline is to relax, but dentists seldom use the supine position. It is ideal for the insertion of foil from the lingual approach and with the head rest of a comfortable type properly positioned, patients do not become fatigued, and, with an operating stool, the operator does not tire.

Fig. 29.—Development of caries at the angles and margins of a filling from insufficient extension, leakage due to poor adaptation, or movement of the filling due to mastication. (After Black.)

right angle automatic mallet will be necessary in order to maintain the correct line of force. My preference is the right angle automatic mallet because it works with a push motion and is more easily controlled in stepping.

If fillings are placed from the labial side and the foil is not thoroughly condensed, and even when condensed and adapted properly, there is a certain amount of flow in gold, which, when the heavy stress of mastication is brought into action on the lingual surface, being in exactly the opposite direction from which the filling was inserted, will often result in fracture of the thin lingual enamel plate, if not previously removed, the filling being driven in the opposite direction from the force that inserted it, and, unless the operator was very skilful, the filling is lost long before its time, because the cavity walls offer little or no sustaining resistance to the continuous force of mastication.

As was stated before, I believe the convenience form of the cavity should be such as will enable the operator to place gold from the lingual surface because the force of mastication is normally from that direction and tends to drive the gold in the same general direction as the force that inserted the foil. Again, owing to the much shorter and much narrower embrasure of the lingual surface, the gold is not so easily condensed in finishing, leaving a lingual surface that chips, is rough and pitted, and invites decay around the margin, especially the linguogingival angle. When placed from the lingual side in a cavity properly prepared for convenience, that surface is as dense and polishes as perfectly as any other surface and will stand up under severe mastication.

Observation has shown that the most prolific source of failure in adaptation is the attempt to condense the gold from both the labial and the lingual approach; that is, malleting a few blows from the labial and then from the lingual on the same pellet of foil, thus driving the gold to the wall of the cavity and next hammering it away, with the result that the filling is not in adaptation to any wall of the cavity and is held in place only by deep grooves, which are always futile, and cannot hope to exclude moisture and stop caries. These are the ones that show a black cloud around the filling a few months after insertion.

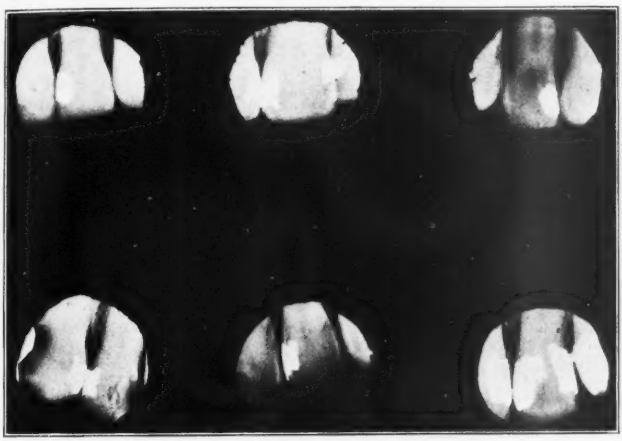

Fig. 30.—Finished foil fillings, showing varying degrees of skill used in their insertion. Those in the upper row show skill in insertion. The one in the lateral incisor on the left of the lower row shows leakage at the gingival margin. The one in the center shows lack of contact, while the distal surface of the central incisor on the right shows contact at the gingival.

We use No. 4 cohesive gold, rolled by the assistant. Noncohesive foil has no place in this type of cavity. Usually, for these cavities, each sheet is cut into five strips of equal width, making each roll four-fifths of a grain. These rolls are again cut into four equal parts approximately 1 inch long, weighing one-

fifth of a grain, which are annealed, laminated and condensed into the cavity.

Annealing of the foil is very important. Its purpose is to restore perfectly its welding property and not to soften it as we do with plate. Any foreign substance, whether liquid, gaseous, salt or oxid, on the surface, destroys the welding property, but most of these can be driven off by annealing, cohesion again being restored.

SEPARATING THE TEETH

In separating the teeth, there are several methods used, such as tightly packing the cavity with guttapercha, tying ligatures wrapped with cotton fibers between the contacts or using one of the mechanical separators; or the one generally used in my office, that of tightly malleting the foil into the interproximal space against the opposing tooth, as the filling is being built incisally and lingually, so the teeth are gradually separated, and when the filling is finished, applying the mechanical separator and lifting them far enough apart to admit the thinnest strip, so that after polishing, it will have a proper contact point. This, together with a proper interproximal space, is one of the greatest factors in a successful operation, rendering comfort to the patient and longevity to the tooth operated on. If you cannot make a gold foil filling of this class in less than three or four hours, don't attempt it on a patient. It would be almost criminal punishment. Cut technic cavities in old toothbrush handles, ivory blocks or anything closely approximating the resiliency of dentin and adapt foil to them until you become more of an adept. In my office, this class of fillings is made more quickly than anyone can make an inlay, with practically no fatigue or discomfort to the patient. It is not an infrequent occurrence to have a patient, when comfortably and properly reclined in the chair, doze off to sleep while we are malleting a foil filling.

It has been my endeavor to show that gold foil is a filling material *par excellence* for proximal cavities of the upper anterior teeth and so induce more men to use it. It will increase your mechanical dexterity along other lines of dentistry; it will obviate continual replacement of synthetics and it will maintain correct mesiodistal width of the dental arch. It is possible to adapt it to the walls of the cavity as it is possible to adapt no other material, and it will save teeth over a long period of years, which is what your patients want; and to that service they are entitled.

730 Majestic Building.

DISCUSSION

William Finn, Pittsburgh, Pa.: Gold inlays have a very important place but should not be used where a gold foil filling can be made. I am speaking of gold foil fillings that are properly made, for one that is not well placed is the poorest kind of filling. Synthetic cements are worthless as a permanent filling often times, dangerous to the pulp and preservation of the interproximal space. I am glad to find Dr. Burns a firm believer in extension for prevention, and I am especially pleased with the removal of the lingual ridge of proximal cavities of the anterior teeth, as the margins are often fractured in placing the gold. I am not fond of making lingual anchorage or steps in the lingual surface of central and lateral incisors, and if I do it is very narrow mesiodistally. I have to differ with Dr. Burns in his cavity preparation in the right central, Figures 19, 20, 25 and 27, as I do not like the lingual anchorage when the incisal angles have to be restored. The anchorage is too far from the line of force. I prefer the incisal step which involves both labial and lingual plates.

R. J. Rinehart, Kansas City, Mo.: Dr. Burns' paper is a résumé of the cavity preparation and insertion of a class of fillings that to the minds of most of us have given far

better service than any others that we have yet accomplished. We have wandered far from the truth of things in our effort to find somethings more esthetic and easier of accomplishment. This is perhaps always true in our course of progress and it leads to two conclusions: either better ways unfold or we prove the value of the old. No one can deny that the greatest piece of art, demanding the greatest skill in dental operations, is the gold foil filling. It has been said many times by teachers and clinicians that the dentist who has developed skill in foil technic can accomplish successfully any other dental operation. It is one of the refining procedures in dental education. It is indeed a fine art. Gold fillings have stood the test of time, and when we review the success of the foil and then think of the many failures of some of the newer materials, it is with deep regret that so many of the profession in the past decade felt that foil no longer had a place in dentistry. I believe I am safe in saying, however, that the present generation of graduates are being more thoroughly instructed in foil work, and these younger practitioners are capable of saving the art.

Dr. Burns has pointed out to us that the contact of the teeth in many mouths has been lost by the use of silicate in proximal cavities. We agree with him. We agree with him also when he speaks of the art of outline form counteracting the color of gold; also when he states that a foil is a time-saver when compared to inlays in the third class cavity. Dr. Burns states that the gingival seat of a cavity must be laid beneath healthy gum tissue because caries never develops under normal tissue. Dr. Black's theory is that the gingival seat should be placed beneath the gum for the purpose of taking advantage of the anatomic shape of the tooth, which allows for a wide base mesially and distally, which gives the greatest amount of resistance and stability to the restoration. In regard to Dr. Burns' technic of insertion from the lingual, his theory seems logical, driving the gold home in one specific direction and in the same direction that stands the force of mastication. However, we have some doubt as to this being a practical procedure for the majority of operators. We would like to ask whether he does not believe that, with his method of preparation, more tooth structure is really sacrificed. Another question we should like to ask is whether he does not believe that to stop the labial margin where stated, defeats artistic outline form, the filling always polished by usage and the best place for immunity. When the incisal angle is undermined by caries and the retention in the incisal would be hazardous, would it not be better to change the type of cavity from a three to a four? Dr. Conzett has explained that placing the dental tubules on tension, they being of resilient material and it being their nature always to resume the natural form by continually asserting this stress in attempting to resume their normal shape, tends to hold our restorations in tight proximity to the cavity wall. It would seem that a direct blow for the insertion of foil is far better than back action, and if condensation is directed as nearly as possible with the long axis of the tooth, having accessibility both labially and lingually a filling may be more easily inserted, the outline form more artistic, the filling in more perfect condition on the labial surface and the place of immunity more ideally located. Contact is another important factor in foil work and it should be located where Nature intended it to be. When we inspect a mouth in which foil fillings have been inserted carefully, contacts properly made and fillings properly finished, we cannot help being impressed with the artistic, serviceable and clean-cut appearance of the service that has been rendered.

DOES THE SCIENTIFIC STUDY OF THE FOUNDATION AND SUPPORTING TISSUES JUSTIFY THE CONTINUED USE OF FIXED BRIDGEWORK?*

By T. A. HARDGROVE, D.D.S., Fond du Lac, Wisconsin

OFTEN, the dental profession finds itself confronted by a division of opinion as to the best way to progress. The time was, in dentistry, when men would come forth with new ideas, and these were accepted as the last word in every phase of study that we made use of in order to arrive at a proper judgment.

Now when a man puts forth a theory, the profession goes to work at once to determine whether or not the scientific principles involved that have led him to his conclusions are well grounded.

We have discussed the advisability of the retention of pulpless teeth as they are related to or are liable to be causative factors in the production of disease. You have discussed it forcefully in this society in a recent debate. Time will not permit, nor would it be fair, to rediscuss that subject in this paper, although it has a bearing on the subject.

There also exists a great difference of opinion as to whether fixed bridges should be discarded in favor of the movable-removable and other types. It is suggested that the so-called fixed bridges do not move in function, which is not true. Fixed bridges do move, and, what is more, if they are properly made, move in the right direction and just about enough.

It is not the purpose of this paper to discuss at all the technic or construction of bridgework, but to deal rather with the tissues that make for success or failure of bridgework.

Crown or bridgework itself is no greater than the support it gets from the tissues in which the teeth are imbedded that have to do with the crown or bridge. So it was my purpose to study in detail those tissues, to account, if I could, for the long service rendered by the so-called fixed bridge.

Biologically and embryologically speaking, the sustentative tissues are the ones with which we are concerned mostly in a consideration of bridgework. They give support to the body and all its parts. They include cartilage, bone, connective tissues, such as tendons, ligaments, spongy and elastic connective tissues, and adipose tissue for the storage of fat, and they find their highest development among the vertebrate animals, of which man is a type.

At an early stage or the end of gastrulation, there are two layers, an endoderm and an ectoderm. Later, from between these two there is developed a

*Read before the Odontographic Society of Chicago, Dec. 8, 1925.

third, or mesoderm. These three layers are known as the germinal layers, for the reason that from them are developed the different organs and systems of the body. The supporting or sustentative tissues are developed from the mesoderm, or middle layer. Nature has her method of selecting certain early developmental tissue and endowing it with characteristics and functions which demand specialized and highly developed tissues to do a particular type of work. It is not designed to do any other type of work, nor will any other type of tissue do the work that this tissue was designed to do so well, if at all. In that class, we find the peridental tissue a sustentative type, endowed with that specialization referred to. Because they are so designed and specialized, they are more complex and more highly developed and for that reason, are more easily destroyed and less likely to undergo repair.

A study of types of attachments of teeth show that they are varied. Teeth attached by fibrous membrane, as in the shark or ray, do not have any direct connection with the cartilaginous jaws, but move over the surface of the cartilage. In fact, they are a direct movable type of teeth. The elastic hinge type of attachment we do not have to consider, but the one we are interested in is the attachment by implantation in a socket, with a development of bone which is molded to the base of the tooth with an intervening tissue or membrane. These tissues are all derived from the mesoderm and plastered around the teeth. The membrane to which we refer, the peridental membrane or alveolodental periosteum, is one tissue and cannot be separated. It is, however, a modified complex tissue, and right here I shall repeat that, as a tissue becomes complex and specialized, its injury, destruction or degeneration is more easily brought about, and the repair of that tissue will be more difficult to obtain.

This modified peridental tissue with bundles of connecting fibers passing back and forth from the tooth to the bone is a specialized tissue and one designed to do a certain type of work. These fibers are thin and smooth as they approach and become attached to the cementum. But as they approach the bone, they become larger and thicker, and, at the cervix, wind over and are lost in the periosteum and cervix gum tissue. I am calling your attention to that particular phase of the connecting tissue because at that point it is more highly specialized, and for that reason must receive more kindly attention.

A fixed bridge can be more easily justified than any other type, because, as you know, the inflammation first appears close to the cervix in a moveable-removable or other type of work. This is due not so much to faulty construction of the work, as is said so often by men in favor of the movable-removable type, as it is to any type of irritation to a more highly specialized tissue.

It is the return of the same irritation to the same cell that eventually destroys the cell or modifies it to such a degree that it cannot function in a normal way, so that, in a large measure, movable-removable bridgework will never become a complete success; while the fixed type of bridgework, if properly made, can protect that tissue.

Now I said that the type of attachment in which we are particularly

interested is that held by ligaments in the tooth socket. That is what the peridental membrane and the fibers that attach the tooth to the socket really are—a dental ligament, prepared biologically, physiologically and anatomically to receive a downward thrust with a very limited rotary movement, in a natural way. That is the reason why a fixed bridge is a success and should be continued, for, contrary to the statement made by some writers, it is a normal stress directed into the ligament itself. If it were not, the tooth would be lost, because every act of usage would be an irritation. As before stated, it is the same irritation returning to the same cell that eventually destroys it, and with the loss of the cell we have loss of the abutment.

I wish to emphasize again the qualifications of the fixed bridge which enable it to deliver normal stress direct to a specialized tissue that is supporting a tooth of the implantation type in a socket. I do not believe that type of exercise can be directed by a movable-removable type of bridge for the reason that, when a tooth is lost, the teeth that are left on either side of the space, having lost a certain amount of their proximal support, are never again quite normal. The fixed bridge reestablishes that lateral or proximal support and it is a help to the life of the abutment rather than a detriment, as is claimed by the advocates of the movable-removable type of bridgework.

Now the function of the cusps of the teeth is not only to incise and masticate the food, but, by their formation and interlocking ability, to direct and control the stress of mastication in a normal way. Dr. Goslee has always emphasized the carving of the cusps in such a way that they would be as nearly as possible the normal type of cusp for that individual. And if the force is normally directed and we have restored the proximal support, we have added to the life of that tooth. In addition, we leave the periosteum and alveolar tissues to rest and reorganization, two great surgical factors in all injury such as surgical interference or extractions.

It can be scientifically proved that, as Dr. Goslee has said, when one of the teeth has been lost, the other teeth will increase their ability to do work if called on to do so. I would say that the supporting membrane or tissue will respond to the new demand made on it, if the bridgework has been properly constructed and the character of the supporting tissue has been taken into consideration. The action of the suprarenal hormone in making available a richer blood supply so that the sustentative tissue can do more work becomes permanent and a normal function can prevail.

Albert N. Crosby, in quoting Professor Cannon of Harvard and T. R. Elliott in their study of the suprarenal glands, brought to light a wonderful hormone mechanism. When we are about to make a supreme bodily effort, the muscles must be supplied with an abundance of oxygen and blood-sugar, the fuel of muscle energy. At the beginning of the increased output of energy, the suprarenal glands are excited by messages passed to them by the central nervous system. They throw into the circulating blood a hormone, which has a double effect, acting on the flood gates of the circulation so that a greater blood supply is

furnished to the muscles, and at the same time, so affecting the liver that the blood circulating through that organ becomes laden with blood-sugar. Here, we obtain a glimpse of the neat and effective manner in which hormones are utilized in the economy of the living cell. It is that influence which is called in and supplies the extra endurance that Dr. Goslee spoke of and the local tissue resistance that prevails when a tooth is taxed beyond its normal capacity to carry bridges.

Clinical history has proved that this is the case by the many fixed bridges that have lasted for years and years on vital teeth and pulpless ones as well. True it is that the peridental membrane seems to be thickened when we examine a radiogram, but it is not thickened because it is diseased; the thickening is a compensatory measure; and this brings us to a consideration of hypertrophies.

There are several types of hypertrophy as there are several types of atrophy: (1) simple hypertrophy (each cell or element increases in size); (2) numerical hypertrophy (increase in the number of cells) called hyperplasia, and (3) physiologic hypertrophy (the increase in size of the uterus in pregnancy, a combination of the simple and numerical).

We have pathologic hypertrophy, the causes of which may be overwork and injury from abnormal work, and that is the thing that should guide us when we determine the size and character of the bridge we are making. This is more noticeable in muscular organs, as in the increase of the heart muscle and its connective tissue.

A pathologically hypertrophied organ may be stronger temporarily than a normal one, but at the same time it is more susceptible to pathologic injury, such as from bacterial invasion. The type of hypertrophy that we are concerned with in the consideration of teeth doing extra work is known as adaptive hypertrophy; or the ability of one organ to do extra work when the other has been removed—simple adaptive hypertrophy of the peridental membrane, just as in the case when one kidney or one eye has been lost, the other functions for both and becomes larger. I will even say that no new cells are formed, as is claimed by some, but not proved scientifically, or otherwise. As nearly as can be determined from a microscopic examination of that type of tissue, it is a compensatory, simple adaptive hypertrophy of a natural tissue receiving an overload of normal work, and as it is established, the overload is adjusted so that the work imposed by a fixed bridge is a more natural process and can better be supported scientifically than by any other type.

The trouble with the movable-removable bridge is that it moves too much and not always in the right direction. As the motion is repeated and carried on, it finally becomes an irritant and will eventually irritate the specialized tissue surrounding the abutment teeth. In the presence of a saddle bridge, the alveolar process itself and the periosteum covering it are not doing natural work, even though the area covered by the bridge or saddle is equal to the area of the roots themselves. The membrane surrounding the roots is a specialized membrane intended to do that work, while the periosteum was

never intended to do that type of work in the mouth, nor can the alveolar process and mucous membrane be expected to retain a normal condition in the presence of something that covers the surface entirely; and sometimes they will not tolerate it.

Regeneration is the tendency to replace or repair the lost or injured parts of organs. The more highly specialized the tissue, the less the power of regeneration. A nerve cell is an example; the heart muscle is another, and the peridental membrane another. If an attempt at repair of the peridental membrane takes place at all, it is by means of hyperplastic hypertrophy, and it is a failure always. The peridental membrane is practically without the ability of regeneration. I have watched it through windows cut in the alveolar process, into the bone on the proximal surface of roots where it was free from external influences, and healing would take place only to the point where the peridental membrane had not been removed. I never have been able to observe regeneration of the peridental membrane. It is the biologic law laid down by Nature that highly specialized tissue is designed to do a certain type of work and it is more easily destroyed and less likely to undergo repair. The work imposed by a fixed bridge, then, is a more natural process delivered to a specialized membrane and can be supported scientifically better than any type of movable or removable work.

The claim is put forward that the alveolar process, in the presence of the movable-removable bridge, will not change—that it will organize and solidify. Those who have performed surgical work in such cases know that when the periosteum is opened and the alveolar process exposed and chiseled into, its density is still that of an alveolar process. Then there is a material change that comes with the advance of years, and if we make a comparison from time to time we shall find that the movable-removable type of work will have to be refitted. This is an indication that there is a change going on in the alveolar process. Even if the bridge caused no irritation at the time it was made, the changing condition of the alveolar foundation would cause it to become a source of irritation to the specialized tissue. Massage is a good thing, but continued massage becomes an irritation. The principle applies here that the same irritation returning eventually destroys the supporting tissue. The slight movement laterally or buccolingually of a movable-removable bridge is liable to simulate in a minute measure the movements carried out by the extractor when he attempts tearing the ligament that supports a tooth. That is true in less or greater degree in all partial work.

CONCLUSIONS

1. In an effort to determine whether fixed or other bridges are liable to be a success or failure, we must study the supporting tissues in which the teeth are imbedded.

2. A detailed study of those tissues brings to light the fact that they belong in the group of sustentative tissues, such as the bones, cartilage and connective tissues, such as tendons and ligaments, and that the membranes holding a tooth of the implantation type in a socket should be regarded in the light of a ligament.

3. A further study of this tissue discloses the fact that it was developed from the mesoderm and endowed and destined, like many other tissues, to do a particular type of work.

4. If called upon to support a bridge, this tissue can be expected to do so because of the fact that it has the power to take on a simple adaptive hypertrophy.

5. Nature, through her scheme of hormone activity, will enrich the blood supply to these tissues and maintain it, so that the function is a normal one.

6. This tissue, highly specialized as it is, is not designed to do any other type of work, nor will any other type of tissue do its work well, if at all.

7. This highly specialized tissue reaches its height of specialization as it approaches the junctions between the tooth, the alveolar process and gum, and, being highly specialized it is easily injured and destroyed, and not likely to undergo repair.

8. It is the return of the same irritation to the same cell that eventually modifies or destroys it.

9. All movable work is apt to be of the type that will irritate that specialized tissue.

10. Every act of usage of a properly constructed fixed bridge is a normal function when directed to the peridental tissue in a proper way, and all removable work demands service that the tissue from which service is expected was never developed to do.

11. The proper interlocking of cusps limits and fixes the force so that the peridental tissue is not abused.

12. The lateral fixing of the movement of abutment teeth in fixed bridgework is not a great menace because it never was intended to have a great proximal or lateral movement.

13. It is good practice to leave the alveolar process, periosteum and mucous membrane at rest if possible where teeth have been lost.

14. Regeneration of the peridental membrane cannot be expected, and the less irritation delivered to the highly specialized or complex cervix, the better. There is no type of bridgework that can be so constructed as to protect that tissue as well as the fixed bridge.

15. The long efficient service rendered by the fixed bridge can be scientifically accounted for by a study of the sustentative tissues supporting the abutments.

16. No type of removable work can be constructed that will treat the sustentative tissues with so much consideration as the fixed bridge when properly made.

17. The removable type of bridgework from the scientific point of view would have to be considered a second choice and looked on as one tolerated with a view of obtaining a varied or fair degree of success.

In preparation of this work, I have had access to the work of different authorities, such as Tomes' "Dental Anatomy," and the work of different authorities on pathology, such as Professor Buntig of the University of Wisconsin and many others, and the principles of animal biology of different authorities and have had the council of Sister M. Janet, pathologist of St. Agnes Hospital, Fond du Lac, Wis.

DISCUSSION

F. B. Noyes, Chicago, Ill.: I am heartily in accord with the principal thesis. I believe that we should elaborate a little the principles brought out with reference to the origin,

nature and function of the supporting tissues. We are apt to think of the tooth, the cementum, the peridental membrane, the alveolar process and the periosteum as separate entities. The more one studies sections of these tissues, the more he will be forced to realize that they are only parts of one thing, that, in the development, the greatest characteristic of all supporting tissue, the connective tissue, is the ability to respond to other environments and change from one form to another. As you study sections of the peridental membrane, particularly from young animals, you will often find the greatest difficulty in determining just exactly the line between bone and peridental membrane. The fibrous tissue is converted into bone. Bone is built up around these fibers and embeds them as the fibrous tissue is transformed into bone. There is no line, or at least it is difficult to put your finger on a line, of differentiation. These tissues, in the development of the individual, show a reaction to their environment, and the particular environment is the support of force. We sometimes say that the fibrous tissue is arranged in a beautiful way to support the force that the tooth receives. That is true, but it is more important to recognize as true the fact that the arrangement is the result of these forces. It is the consequence of a reaction to these forces. Now, if this is true, and it certainly is, the tissue which should support that kind of strain is the tissue which Nature will build in response to that sort of strain, which is the confirmation and establishment of the principal thesis of this paper. Now to what extent the peridental membrane is capable of regeneration is perhaps not entirely germane to this discussion, though it is referred to by Dr. Hardgrove. I am in an unpopular position, and alone, on that subject. I still believe that the peridental membrane has great power of regeneration, greater than it is given credit for. The limitations of that regeneration we do not know, and we never will know until we have some sort of control experimentation. The connective tissue of the peridental membrane contains a considerable amount of tissue of an undifferentiated type, together with bundles of fiber of a highly specialized type. The tissue between those bundles of fibrous tissue constitutes what Dr. Black used to call the interfibrous tissue, which is an unspecialized type of fibrous tissue. In that tissue, we have a considerable number of undifferentiated connective tissue cells which still have the capacity of developing in various directions. According to the physiology of the tissue, we know that we have cells becoming osteoblasts, cementoblasts or fibroblasts. Those are the three differentiated directions of specialization in which certain of the undifferentiated connective tissue cells have the power of development. When conditions demand it, we have cells capable of destroying fiber tissue, bone and cementum appearing in its walls. These cells are not always there. We may make thousands of sections and find no trace of them, but the moment we put the tissue under conditions that demand their presence, they appear. There has been a great deal of discussion as to the origin of osteoblasts and osteoclasts. I believe it is not settled yet. A Chicago worker has done a great deal of experimentation on that particular subject. If undifferentiated cells are present, in certain types of injuries at least, I see no reason why repair may not occur. Many years ago, I started some work along these lines, carrying it out on dogs, in two or three different ways. The object was to test the regenerative power of the peridental membrane in the repair of artificial injuries of the peridental membrane. The dogs all died of the mange before regeneration had gone far enough to be conclusive. No one else, to my knowledge, has repeated the experiments or carried them further. I have always planned to do it, but no opportunity has ever been presented. In the dogs in which regeneration had gone the farthest, there was a definite indication of a return of the type and arrangement of the tissues in the normal structure. A report of this work was published.[1] In places on the edges of that wound there was a reappearance, a reformation of bone, typically arranged, a reproduction of the alveolar process that had been injured, and in the cementum, a beginning absorption and also a rebuilding. In these positions, there was a definite indication of reattachment of the fibers. I do not think that has anything to do with the support of the bridge because we do not do that kind of thing to peridental membrane. The important phase of the discussion as presented by Dr. Hardgrove seems to me to be in replacing the support of fixed bridges by abutment, and if the restoration is such that the forces are equally distributed by the cusps, the reaction on that tissue will be a close imitation of its

1. Noyes, F. B.: Dent. Rev., 28: 883-892, 1914.

natural function, only increased somewhat in amount. What would you consider the meaning of the thickened membrane? The addition of two teeth, or the force received on two teeth in addition to the one which makes the abutment, increases the amount of force that that membrane receives and it increases also, slightly, the amount of movement that that tooth shows in function. The thickening of the membrane I should think would be a perfectly normal reaction for that necessarily slightly greater movement and nothing more. I do not believe anybody has cut sections of peridental membrane through such areas. It is not the reaction that we would expect from the response of that tissue to infection. It is not the response that we have in cases of infection beginning in the gingival space and progressing into the peridental membrane. It is an entirely different type of thing. I would like to stress one thing which I think the essayist did not stress, although he implied it; that is, the ability, in the production of a fixed bridge, to reproduce the protection to the supporting tissues which is given by the natural tooth form. Those tissues are placed around that tooth with reference to the gingivae in such a way that the impact of food passing from the surfaces of the tooth in mastication is guided over and across the gingivae and the gingival space is protected. The anatomy can be better reproduced in fixed bridges than in the removable type. There is no question, from the standpoint of the tissues, that the periosteum covering the alveolar process was not designed to receive the occlusal force received by the cusps and crowns of the teeth; the peridental membrane was designed for that purpose. We should call attention to one thing, and that is, that the force should be directed in the natural relation to the axis of the tooth. In too many cases, the tooth is not restored to its normal axial relation before the bridge is placed, and the abutment is placed on the tooth, which is already out of harmony with the occlusal force, and it now receives a greater occlusal force in its abnormal direction. This is an exceedingly important factor with reference to fixed bridgework. More bridges would be longer in service if the teeth were restored to their normal occlusal place before they were obliged to carry the occlusal force of the restoration. With reference to the support, the argument is all in favor of the fixed bridge. The only question is that of cleanliness. One advantage of the removable bridge is its ability to be removed and cleaned; one disadvantage of the fixed bridge is the difficulty of preventing the inaccessible parts from becoming covered with colonies of microorganisms, which are constantly being detached from that position and carried into places where they will affect the soft tissues. I wish that it were possible to bring to you real evidence of sections through the peridental membrane that have carried bridges. Until we have some, we will be only reasoning from what we know to what we do not know, which is, from a scientific standpoint, always dangerous, except as it is tested by observation.

Earle H. Thomas, Chicago, Ill.: Dr. Hardgrove said that fixed bridges will move in the right direction and just enough, if properly made. I would say that is unquestionably right: if properly made and not subjected to too much strain, they do move. Dr. Hardgrove said, further on, that the tissue is more highly specialized at the gum margin. In removable bridgework, inflammation appears close to the cervix. Further, it is the return of the same irritation to the same cell that eventually destroys or modifies it so that it cannot function in a normal way. I would say that movable bridgework can be so constructed that it does not irritate the gingival tissues. The term removable bridgework includes many different types, and the exact type should be referred to in any comparisons. Removable bridgework is any bridgework that can be removed from the mouth. One type of removable bridgework can be locked on abutment teeth, just as fixed bridgework, and if it is made so as to fit the abutments, it will have the same effect on them as fixed bridgework. The closer we stay to that type of work the better. When we get into this movable-removable bridgework, so-called, in which there is individual movement in three or four places, causing the abutment teeth to move a greater degree than is ordinarily expected of them, we get into trouble, and as Dr. Hardgrove said, the trouble usually starts at the gingival margin where the tissue is more highly specialized. The irritation breaks down the tissue, and eventually the teeth are lost. Dr. Hardgrove states that, when teeth are lost, the teeth on either side of the space lose a certain amount of their lateral support. If a removable

bridge is made right, that lateral support will be reestablished just the same. We cannot compare a fixed bridge made right with a removable bridge not made right. Along that line, I think one of the main places where trouble starts around most bridges is on the side of the abutment next to the adjoining tooth, and this is the result of not restoring a proper contact point. When the contact point is not good, food packs between the teeth, destruction of the alveolar process resulting. The formation of cusps and their interlocking ability can be as good on removable as on fixed bridgework. The latter leaves the periosteum and the alveolar process at rest, and Dr. Hardgrove refers to the principles of surgery as indicating that such tissue should be left at rest. One main principle of surgery is that injured tissue should be left at rest until it is well and then it should be made to function. If a fixed bridge is put in, no function is given to the alveolar process between the abutments, and that tissue is more liable to disappear than that under a removable bridge, where there is a little work given the tissue. Dr. Hardgrove states that when one tooth is lost, the other teeth will increase their ability to do work. That is true, if the work given to those teeth is a reasonable amount. When we start putting on bridgework and making one tooth do the work of several, that tooth will not support the work. It is a matter of judgment as to the number of pontics one abutment should carry, but undoubtedly a tooth will adapt itself to additional work. Dr. Hardgrove spoke about the pericemental membrane around abutment teeth appearing thickened in the radiogram. In the average bridges I have seen, I do not think the pericemental membrane has appeared thickened. The pericemental membrane is thickened only when the bridge is carrying more stress than it should. A little irritation will gradually make the tissue more sclerotic. The tissue will adapt itself, and the membrane itself will get harder and will stand more stress without getting thicker and without hypertrophying, simply because the stress will gradually make that membrane sclerotic, and the cells harder and more compact, and possibly the membrane appears thinner in the radiogram than would be normal; whereas a greater amount of strain than normal will make the tissue hypertrophy and show in the radiogram as thickening. As Dr. Hardgrove said, the membrane is not diseased, but the hypertrophy from the abnormal stress on it makes the membrane appear thicker in the radiogram. Sometimes it is so thick around the apex that it is hard to believe that the tooth was not abscessed. That means that the membrane lays itself open to disease more readily in those cases. In the removable bridge that causes such excessive strain around the gingivae, we have what appears to be pyorrhea, but in the early stages, it is not destruction but simply a hypertrophy of the membrane in that region. Dr. Noyes took up the question of the new cells and as to whether or not the pericemental membrane will regenerate. The pericemental membrane all through life consists of the same cells—the cells do not keep changing. It is the same cell that gets larger or smaller. If there is little extra work, it will get smaller and sclerotic; if considerable extra work, it will grow larger and hypertrophy. From practical observation the pericemental membrane will regenerate, but that depends on what we mean by regeneration. It will reattach itself to the tooth, if the cementum is alive. Also, if the pericemental membrane is removed and ordinary soft tissue is placed in contact with live cementum, the fibrous cells will attach themselves to the cementum, and, in time, they will change and become pericemental membrane, perhaps not a true pericemental membrane, but one that functions like it. Dr. Noyes spoke about protecting the gingival tissues from food by building up the abutment to a proper contour so that the gingival tissues are protected. In my opinion, a gold crown that does not come within one-eighth inch of fitting at the gum margin will last longer than one fitting perfectly but not contoured properly. One other indication that pyorrhea is a constitutional disease is the fact that there is not so much irritation from calcific deposits as there is from a gold crown that does not fit, and yet I have seen crowns that have been on for thirty years without much gingival resorption. A bridge, whether removable or fixed, should be checked for occlusion or contact with the opposing teeth not only when made but also several months after, because we often find, on reexamination, that the abutment teeth have changed their position slightly for the reason, probably, that the stress is not brought in the right direction, and thus we have a malocclusion of the entire bridge. Sometimes the pulps are taken out in order that a fixed bridge may be put

in. In the light of our present knowledge, the man who takes out the pulp of a healthy tooth to put on a fixed bridge, is bordering on malpractice. To illustrate that extra strain can be endured by abutment teeth: Take a tooth that is broken off, thus losing its occlusion and function, and after a few months that tooth can be easily extracted. Conversely, a little extra strain put on an abutment will make it harder than usual to extract. Dr. Hardgrove's paper will make us all think, and that is something we all need.

Otto Krause, Milwaukee, Wis.: We have heard a great deal about fixed and removable bridges. We heard a good deal, in the past, about the fixed bridge being a menace and having no place in dentistry. It is true that, in the past, many of our bridges had no place in the mouth. They were constructed with no consideration of engineering, physiology, sanitation or esthetics. I want to emphasize what Dr. Noyes said about bringing the proper anatomy to the fixed bridge. I have experimented and placed some crowns on teeth, giving the proper form, fit, etc., and I have evidence in many cases that the tissue conditions are normal and will stay normal for many years. Dr. Noyes said that it is easier to clean a removable bridge than a fixed. Nothing is cleaner in the mouth than the patient wishes to keep it. By proper education of our patients and by making a fixed bridge properly, these cases can be kept as clean or cleaner than removable bridges. We have clinical evidence to prove that a fixed bridge properly made will last many years. We know that the bridges that have been criticized have been made under all sorts of conditions. Today, we have the roentgen ray, and we can have an exact picture of the condition of the root and surrounding tissues. When we make a bridge today, with a knowledge of the anatomy, we will have no trouble. Fixed bridges sometimes stand up for years. I spend a good deal of time in my office on the adaptation of bridgework. I do not believe that I can make a bridge from a metal or plaster cast and have an exact reproduction of the under surface. I spend a good deal of time on the under surface of the bridge. If that method is followed, and the patient is taught how to care for the bridge, using tape, brush and syringe, the results will be gratifying.

Dr. Hardgrove's paper should be studied carefully. He is a surgeon-dentist, and what he has told you tonight I know he has done.

F. B. Vedder, Ann Arbor, Mich.: One thing that has been evident to all of us in listening to this paper is the fact that Dr. Hardgrove has taken as his premise well designed and well constructed fixed bridges. Another point that was brought out by Dr. Thomas in his discussion is that, while some of these removable bridges are readily removable, they nevertheless act as fixed bridges, and it is my contention that any removable bridges, whether it be movable-removable or simply removable, will, at some time or other, act either as a fixed bridge or as a partial plate. As I understand removable bridgework, it is designed and constructed with the idea that part of the stress of mastication shall be borne by the abutments and part by the mucous tissue and the alveolar process that underlies that tissue. It is my contention that this condition can be maintained for only a limited time, depending largely on individual variations. At some time during the life of the bridge, there will be a recession of the alveolar process and the underlying mucosa; that is, these tissues have a tendency to "get out from under," and they do this in practically all cases in which any load is thrown on them. The removable bridge then becomes in effect a fixed bridge in that it throws all of the stress on the abutments or it settles to such a point on the soft tissues that it is no longer an efficient help in mastication. Frequently, it settles to such a point that it no longer fits, and is an actual menace to the abutments. If we are to construct these removable bridges to maintain any degree of efficiency, they must be so made that they can be adjusted; that is, so that they may be raised by rebasing. As I have said before, the amount of recession that takes place and the frequency of the need for rebasing depends largely on individual variations and to some extent upon the size of the saddle. A fixed bridge, if properly designed, may be kept clean if the patient is instructed in its proper care. In the majority of mouths, I believe that fixed bridgework is more cleanly than removable. If the fixed bridge is properly constructed, it may be cleaned in the same way that the rest of the teeth are cleaned; that is, by the toothbrush, the movements of the food during mastication, and the movements of the tongue, cheeks and lips; while with the removable type of bridgework, the saddle can be cleaned only when the patient removes the bridge. The removable bridge

is undoubtedly cleaner five minutes in twenty-four hours than a fixed bridge, but for the rest of the twenty-four hours, as far as cleanliness is concerned, I prefer the fixed bridge.

I cannot agree with Dr. Thomas when he says that the removal of a pulp for the placing of a fixed bridge borders on malpractice. I do not want to start a discussion of pulpless teeth here, but there are many cases in which to leave a pulp is to leave a wrecked mouth or to put the patient in the full denture class: for instance, those cases in which a lower molar has been extracted in early life, and the upper molar has elongated to such an extent that no type of restoration can be made which will permit any degree of mastication. In these cases, the only thing that can be done is either to extract the upper molar or to extirpate the pulp and grind the crown down to a place where some sort of restoration can be placed on the lower. There are few other instances in which the extirpation of a pulp is absolutely necessary. The one instance that I have given is typical.

James C. Mortenson, Milwaukee, Wis.: This argument as to whether we should use fixed or removable bridgework seems to me to be a repetition of the situation that once pertained to the inlay. When the inlay first came out, it was condemned because some men advocated the use of the gold foil filling. The gold inlay today has found its place, and we no longer hear any more argument as to the gold inlay replacing the gold foil filling. The removable bridge has not reached the same point that the gold inlay has, but I think that as time goes on it will find its place. There should be no argument among intelligent men as to whether we should use a fixed or a removable bridge, because each has its place in dentistry. My brother and I have been using the movable-removable type of bridgework for the last eight years, and had our experience been as disastrous as some men would lead you to believe was possible, we should certainly have discontinued it. We are as conscientious as we know how to be, and had this type of bridgework been so detrimental to the tissues in the mouth, we would have discontinued its use. We do not claim that movable-removable bridgework should be used to the exclusion of all other types, but that it has its place in the mouth. If the same amount of care is given to a removable bridge, as Dr. Hardgrove advises, the removable type of bridge will be just as much of a success as any fixed bridge that was ever placed in the mouth. In certain cases, I believe that it is more successful, and a more nearly ideal restoration to place in the mouth. For instance, if a first molar and second bicuspid are to be replaced and the bite is a very close one, there would be a large surface in a fixed bridge which would be in constant contact with the tissues month after month, and it is impossible for the patient to keep that clean. The removable type can be so constructed that it is possible for the patient to keep it absolutely clean in the mouth. The injury to the gingival ligament, which Dr. Hardgrove stresses, is no greater in the removable bridge than in the fixed bridge unless it is so constructed that part of the saddle impinges on the gingival tissues. I wish I could show you the condition of the gingival tissue underneath some of our removable bridges. We are not advocating the use of removable bridgework entirely; we would not care to practice without making use of some fixed work. The condition of the underlying tissues is the important thing. We feel that we have been just as successful in keeping this tissue healthy in our removable bridgework as we have in our fixed work. It is a regrettable fact that so few men so construct their bridges, or so instruct their patients, that they can be kept clean, because the great majority of these cases that come to our office are not kept as they should be and are in just the condition which Dr. Noyes described. It would be impossible for the patient to keep some of these fixed bridges clean because they are not constructed properly. The same is true of many of the removable cases. After all, bridge replacement is far from ideal in the mouth of any patient. I wish it were not necessary to replace missing teeth. In view of the fact that we are obliged to give our patients something, it seems to me that the men who practice bridgework should use the method that is best suited to the particular case. There is a borderline between fixed bridgework and partial platework that can be filled only by the removable bridge. I think the best type is the movable-removable. It is this kind of dentistry that we want to practice. I think there are other men, who, if they understood what movable-removable bridgework does in these cases, would use it more. I do not care whether we use movable-removable bridgework, partial plate or fixed bridgework; if properly constructed, each has its place. The

movable-removable type of work does throw a large percentage of the work on the abutting teeth, but they are able to stand the strain. A great deal has been said about the absorption of tissue underneath these removable cases. The movable-removable type of bridgework which we are making does not prove any claim of this kind. I would be glad to show cases of movable-removable bridgework that have been in mouths for eight years. The imprint of the saddle can be seen on the tissues in nearly every one of the cases. There is no irritation to the tissues underneath. Radiographically, the bony structure underneath the saddles shows greater density than that beneath any fixed bridgework that has been in the mouth the same length of time. We have a large number of slides showing this. We have followed up these cases, and, in nearly every case, we find what we consider a more normal condition of the bone underneath the saddle. If removable bridgework is not so good as any fixed work in the mouth, it is only because it has not been properly constructed.

C. N. Johnson, Chicago, Ill.: When we begin making startling statements condemning certain restorations, we should think of the number of cases that have lasted in patients' mouths for twenty or twenty-five years and have kept those patients from the necessity of wearing dentures. It is pretty hard to shake my belief in that kind of work. It is the practical experience year after year that Dr. Mortenson has referred to that, in the ultimate, must teach us the lessons we wish to learn. I have felt that in other subjects as well as in this, when we sit down and reason these things out, it is the practical experience that will bring the safest lessons after all.

G. W. Dittmar, Chicago, Ill.: I have one question to ask in the hope that Dr. Hardgrove or Dr. Noyes may answer it. Speaking of the peridental membrane and the fibers of the peridental membrane, Dr. Thomas left with me the impression that the fibers were made of cells and that these cells were not replaceable or were not like other cells in the body. In other words, he would lead me to believe that they were similar to the ameloblasts, the enamel cells. The peridental membrane, to my way of thinking, is a vital tissue receiving nourishment and rebuilding just as do other tissues.

Hart J. Goslee, Chicago, Ill.: Reference has been made to the evolution of the gold inlay and the statement has been made that it has found its place, which all of us know to be quite true. I want to apply the same simile to fixed bridgework. Prior to 1914 or 1915, many were building fixed bridges, and thought they were rendering good service to their patients, when suddenly a Moses came along and told us we are not rendering good service and that there is absolutely no place in dentistry for fixed bridgework. After that statement we were told that fixed bridgework tore teeth out of their sockets; that anyone who placed fixed bridgework in the mouth was practicing criminal dentistry; that the only place for fixed bridgework was in the mouths of very elderly people who would not live long enough to have any damage done, and that the dental colleges of the country had no right to teach this branch of restorative dentistry. In the face of such statements, what did those of us who had been putting in fixed bridgework and who had been led to believe that we were doing honest, conscientious service to our patients, think? We had to stop and think whether we had really been doing honest, conscientious service or not. Many, for a time, felt that perhaps those statements did have some foundation. Many hesitated for fear they were wrong and that the statement might be correct. But, after a while, we found our patients still returning with fixed bridges giving every evidence of health and of efficient service, and we wondered if we must tear out these fixed bridges and replace them with a removable type in order to comply with the mandates of those who said we were wrong. The only effect such statements had on me was to cause me to be a little more cautious, to build fewer large fixed bridges and to be more careful in observing the requirements of sanitation. Those are the things which we learned from these arbitrary and scientific mandates which were handed down to us and, as we observed these essentials and continued to employ fixed bridgework, we realized more and more as time went on that we were rendering good service to our patients. I have felt all along that any one tooth in the arch could be reasonably expected to do more work than originally intended or required of it, but, as I wrote Dr. Johnson two or three years ago, I could not prove it. Many of us have seen these fixed structures built as carefully as we know how

to build them and otherwise standing up and giving good service from periods of from five to thirty years. Why should we abandon such a practice? And so I say to you that, with the evolution of fixed bridgework, it has finally found its place and that it is to be regarded as one of the most efficient means of supplying missing teeth in the partially edentulous case. A year and a half ago, I overheard a statement made by Dr. Hardgrove in which he supported me in the premises I have taken, and I immediately asked him to prove scientifically just why fixed bridgework did render efficient service over so long a period of years, and as a result I am actually responsible for the splendid essay he has given tonight. Your attention has been called to two very vital issues. One is that the gingival tissues must not be constantly irritated else they will degenerate, and, in my judgment, any form of removable bridgework offers more irritation to the gingival tissues than a properly constructed fixed bridge. The next most important statement, made by Dr. Noyes, and later emphasized by Dr. Thomas and Dr. Krause, was that no bridge can be any cleaner than the patient can keep it and that we have no right to place anything in the mouth that cannot be kept clean. After several years of study and observation, I think we are all safe in averring that the evolution of fixed bridgework proves conclusively that, used when indicated and built properly, it is the best means that we have at our disposal for all small restorations. Dr. Hardgrove has accomplished an important, outstanding scientific achievement. We knew fixed bridgework did render good service, but we did not know why or how scientifically. He has told us.

Dr. Mortenson: We have never made the statement to you that we were using other than removable bridgework. The impression that you have had has been wrong.

Dr. Goslee: I apologize to Dr. Mortenson for quoting him incorrectly, if I did so, but I would not be surprised if somewhere back in print I could not find that statement by him or his brother.

Dr. Hardgrove (closing): I did not intend to discuss technic or construction. My whole effort was to study the tissues in which the tooth was imbedded. Dr. Noyes discussed the subject from my angle, as he is so well trained to do it. He told about tissue responding to environment, both bone and connective tissue, and of course it does that up to a certain point. When the environment has been established, certain biologic principles have grown into the scheme. In the animal scale, we find that certain tissues have been endowed with certain principles. Although environment plays an important part, there comes a time when the selective evolution of the development of tissue becomes evident. There is nothing truer than that we can expect from a certain germinal layer a certain type of tissue, and a certain function at maturity. If the suggestion regarding the peridental membrane is true, I can understand how fibroblasts may be able to revert to embryonal activity. That has not been my observation, and if there is a regeneration of peridental membrane, it has not been very evident. If you will study the question as I have, you will find that that is true. For instance, in one case I was called on to remove a large cyst in the region of a cuspid tooth. I opened into it and removed the cyst, and found that the latter, by pressure, had destroyed a certain area of the peridental tissue on the mesial surface of the cuspid root. This seemed a good opportunity to determine whether we could observe anything in the way of regeneration. The cyst itself had not become infected but was filled with ordinary cystic fluid. Examination did not show that bacteria were present. Infection must come from the mouth itself. The lesion healed, but I could find no sign of regeneration of the peridental membrane. We have all had the same experience as Dr. Noyes had in getting sections. It is hard at postmortem to get consent to take some of the tissue. Cleanliness is a thing that can be accounted for only by the care the patient gives the bridgework, the skill with which it is made and the instruction he receives from the dentist. I have seen some of Dr. Krause's cases and I can see no reason why a fixed bridge cannot be kept clean. Dr. Thomas speaks repeatedly of the peridental membrane becoming thin and strong. His conclusions from studying living pathologic tissue have to be taken into consideration. We can expect no more energy, no more work, no more service from any tissue than can be supplied to it by the blood. We certainly cannot expect a greater circulation in a sclerosed membrane, so the argument cannot be well taken. Dr. Thomas spoke of regeneration, as did Dr. Noyes, who cited an interesting experiment in which a bur was used to go through to the peridental membrane and destroy it. He

watched where the healing took place. That experiment was not complete. I can conceive of the membrane outside closing over that space and becoming cured, but to complete that experiment we should have to section it to see whether we had a true peridental membrane. I can conceive of a hyperplasia being present for a time. All our evidence so far goes to show that regeneration of peridental membrane does not take place.

I simply made the statement that any bridge or partial plate, be it removable or fixed, which depends on the periosteum for part of its support is expecting from that tissue a service which it never was intended to render. If you think you can maintain a normal condition of bony structure by so-called vibration, which may be detrimental, you are mistaken. You are not producing intermittent vibrations, Nature is doing that, and intermittent vibrations will be no better with the mucous membrane covered than without. Regarding Dr. Mortenson, we have no doubt as to his skill to produce wonderful work. You are open to some criticism in studying this proposition from a scientific point of view if you depend on the periosteum for part of your support, because two or three dummies on a removable bridge will not remain stable, nor will the bone remain stable. As time advances, the bone will shrink. The mechanical evolution of any type of bridgework does not interest me just now because it is the tissue supporting the structure that I am interested in. Eight years is no test for bridgework, removable or fixed, as compared with twenty or thirty years of the fixed type. How many of you have seen wonderful fixed bridges that have lasted for twenty or thirty years, made by men who were careful and did their work well. And how little they knew about it twenty or thirty years ago. The dental ligament cannot be so well protected with the removable type as it can with the fixed type for the reason that no removable type can be made that will be rigid enough to direct that strain directly into the capsule. I do not care how carefully we make that removable type, we have some points that are not going to be rigid.

Dr. Vedder made a wonderful discussion from a technical point of view when he described a bridge that is so made that the saddle fits, but in a few years has to be remade. It is contrary to the principle of physiologic activity in middle life to expect bones to remain normal under stress of that kind. As to Dr. Dittmar's question as to whether a new peridental membrane is formed, I would say that the peridental membrane is no different from tendon or bone cells. We have the same tendon today as when we were born except that its substance has been renewed. There is no replacement or new tendon. Nutrition is brought to it, and waste material is taken away.

I was stimulated to make this investigation because I knew the statements that Dr. Goslee had made were the result of honest observation; and when you have made an honest observation, and it has been borne out by other operators working in the same field, and clinical experience has justified your observations over a long period of time, you need not, as a rule, be afraid of scientific investigation.

FURTHER STUDIES OF SKULLS IN RELATION TO PERIODONTAL DISEASE

By ISADOR HIRSCHFELD, D.D.S., New York City

(Read before the Section on Orthodontia and Periodontia of the American Dental Association, Louisville, Ky., September 22, 1925)

IN a previous paper,[1] I stressed the benefits which a periodontologist may derive from a study of a large collection of skulls such as is to be found in the American Museum of Natural History. This source of information should play an important part in the future development of periodontology.

In the presentation of a study of skulls in relation to periodontal health in a single paper, one is compelled to limit his use of material and observations within rather severe bounds. The subject matter, at this time, therefore, will be confined largely to a discussion of occlusal wear in relation to periodontal health and disease, and only those observations at the Museum will be included which have a direct bearing on this topic.

OCCLUSAL CONTOUR

The relationship of occlusal contour to periodontal health and disease is probably the most fascinating phase in a consideration of the biophysics of periodontology. The romance of the cusps is worthy of eloquence. The rounded contour of these, of the ridges, and of the lesser occlusal prominences, as well as their respective strategic locations and positions, are physical assets in the maintenance of normal function and health. Throughout the continuous modifications in the character of the occlusal contour brought about by wear, corresponding changes take place, not alone in the form and size of the pulp chamber but even in the periodontium, which withstands the stress occasioned by occlusal pounding.

In the early years of childhood, when the jaws are small and tender, and the masticating muscles comparatively weak, the crowns of the deciduous teeth tend to taper occlusally, i. e., the buccolingual diameter of the molars at the points of the cusps is short as compared with that of the alveolar rim, which forms its fulcrum during mastication. The tendency of the crown to be cone-shaped, with the centric or working cusps practically opposite the center of the diameter of the alveolar rim, results in physical advantages which are easily discernible. Normally, such mechanical construction minimizes the strain on the tender periodontium and requires less dynamic exertion on the

1. Hirschfeld, Isador: J. Dent. Res., December, 1923.

part of the small masticating muscles. In addition, it is conducive to greater penetration into, and easier maceration of, the food masticated. The great spread of the roots is no doubt an additional advantage.

Let us consider the permanent teeth. (Fig. 1.) At the time of their eruption, their buccolingual diameter at the cuspal points is shortest and the occlusal prominences are a series of normally rounded convexities. These mechanical features suggest a maximum functioning efficiency and a minimum strain on the periodontium. The latter, especially, is an advantage in view of the fact that, at this time, the roots are only partly developed, and the pericementum is very thick and yielding, and the alveolar process thin and likely to give on undue pressure. Fitting in with this mechanical scheme of minimum strain is the comparatively weak musculature which furnishes the dynamic force. Thus, once more, there is a coordinated arrangement conducive to economic functioning.

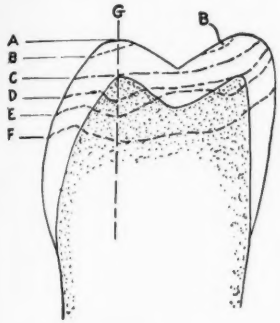

Fig. 1.—Diagrammatic cross-section of a lower molar, outlining progressive changes in occlusal wear: *A*, normal convexity of cusp (not worn); *B* (left), small facet making its appearance at the beginning of occlusal wear; *B* (right), concavity which may appear on the lingual cusp at the same stage; *C*, almost complete disappearance of the buccal cusp with a slight exposure of the dentin, the lingual cusp being only partly worn away; *D*, buccal cusp completely missing and the concavity now formed in the dentin having its greatest depth opposite the point of the original cusp, as shown by line *G*; *E*, concavity in the dentin of the lingual cusp, the enamel in the center of the occlusal surface being still in evidence; *F*, disappearance of enamel in center of occlusal surface and fusion of concavities in the dentin.

Fig. 2.—Occlusal wear resulting in exposure of dentin opposite the original cuspal points. The buccolingual diameter of the incisal surface is greater in the central than in the incisors. This occurs often, but not always.

As each succeeding change in the character of the occlusal contour gradually takes place, through wear, there is a readjustment of the component parts of the masticating apparatus. The entire picture changes kaleidoscopically. The convexities of the principal and minor cusps and of the various ridges become constantly widening facets, which may eventually merge into each other, forming larger facets or planes. According to laws of physics, the crushing power of occluding planes is less

than that of convexities; therefore, since normal functioning now requires a greater dynamic force and rigidity of the parts, we find, accordingly, greater muscular development, thinner periodontal membrane, and thicker alveolar process associated with the occlusal facets.

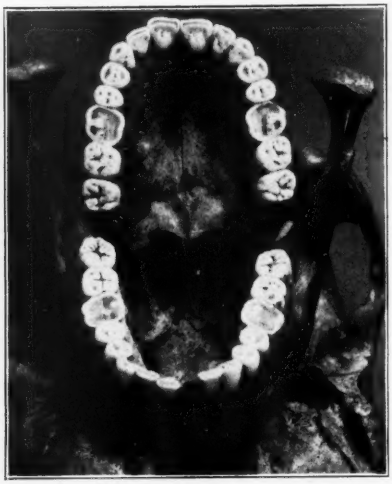

Fig. 3.—Denture in which wear in the first molars is greater than in the other teeth. The wear in the centric cusps is also usually greater than that in the eccentric.

Later, along with further changes in occlusal character, a still greater strain is developed. The planes resulting from the gradual wearing away of the cusps are themselves worn down further till the dentin underneath is exposed. As this tissue is softer than the enamel, it yields much more readily to the abrasive action of coarse substances and wears away faster, thus producing concavities where before there were sharp convexities. (Fig. 2.) Though small at first, these concavities become larger and larger through continued abrasion, until the entire occlusal surface is one large concavity of greater or less depth, with the buccolingual diameter, probably, at its maximum. The eccentric border of the occlusal surface, extending far beyond the confines of the alveolar rim, now produces tremendous leverage during mastication. (Fig. 3.) In some instances, extrusion of the tooth out of the alveolus, due to excessive wear, further accentuates this leverage. From a purely mechanical point of view, the combination of this extreme leverage plus the maximum muscular development obtaining at this time should by

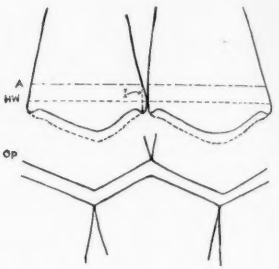

Fig. 4.—Above: Horizontal wear. *HW* indicates wear to the extent of obliteration of the marginal ridges and grooves, also of the occlusal embrasure. An examination of skulls leads one to believe that this, by itself, may not affect the alveolar septum, *I* shows approximal wear. Contrary to the belief expressed by some, neither this nor the reduction of the mesiodistal diameter, resulting from advanced occlusal wear (*A*), will alone tend to cause food impaction between the posterior teeth, because the anteroposterior V-shaped relationship between the occlusal planes of the maxillary and mandibular arches during mastication tends to crowd all the posterior teeth in a mesial direction. This holds them tightly together. Below: Mesiodistal occlusal planing. This tends to produce food impaction.

itself prove destructive to the periodontium, but it is interesting to note that it does not—the defensive biologic element plays its part—according to the evidence arrayed in the skulls at the Museum, as pointed out elsewhere in this paper.

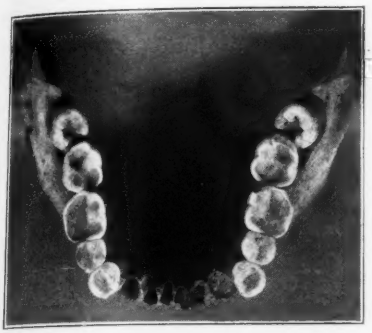

Fig. 5.—Denture showing marked concavities in the exposed dentin of the first and second molars; obliteration of marginal ridges and grooves, also of occlusal embrasures, and marked interproximal wear.

The above described concavities in the dentin are, in most cases, produced, not by the opposing teeth themselves, but through mechanical abrasion by foods and other substances. In skulls, it is possible to view from all angles the occlusal contact between opposing teeth during the excursion of the mandible from one extreme end to the

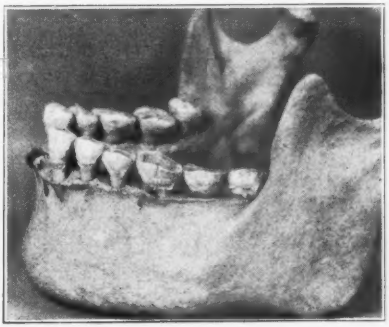

Fig. 7.—Denture shown in Figures 5 and 6, having apparently healthy alveolar septums in spite of changes described in Figure 6. In the mesiodistal planing type, loss of the marginal ridges and grooves would be likely to result in food impaction and interdental destruction. Nonpathologic root denudation is here caused by tooth extrusion due to extreme occlusal wear. The eventual exposure of the bifurcation to the mouth flora may result in infection at this point.

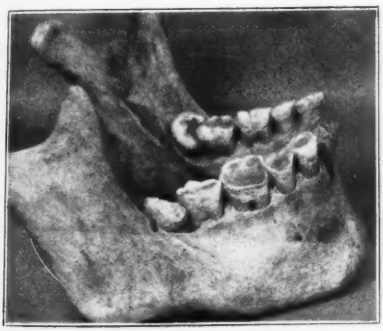

Fig. 6.—Side view of denture in Figure 5, showing normal alveolar septums, and extrusion of the first molar resulting from extreme occlusal wear; also the bifurcation in same tooth denuded of alveolar covering.

Fig. 8.—Radiographic view of denture shown in Figures 5-7.

other, and it is often found that the depth of these concavities cannot be reached by any part of the opposing

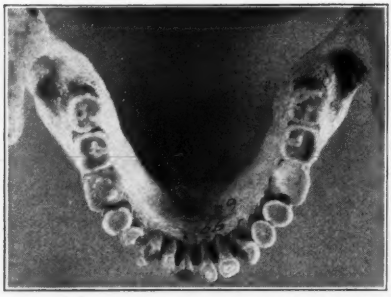

Fig. 9.—Mandible with occlusal wear similar to that in Figures 5 and 6, only to a greater degree, reaching down beyond the original contact point. Contrary to the belief of some writers, this does not necessarily result in food impaction and destruction of the septal process. This mandible is a concrete demonstration of line *A* in Figure 4.

teeth in any position of the mandible. Furthermore, in mouths in which mastication takes place habitually on one

Fig. 10.—Side view of mandible shown in Figure 9.

side only, deep concavities may be formed on that side; while, on the other, the exposed dentinal surfaces may present merely facets or planes. Since the surfaces of the concavities are highly polished and hard instead of etched and soft, it is evident that mechanical abrasion rather than chemical erosion brought them about.

OCCLUSAL WEAR

Generally speaking, the type, extent and rapidity of occlusal wear may be modified by the following factors: 1. The original form of the tooth. 2. Its position and location in the arch. 3. Its mesiodistal or buccolingual relationship to the opposing teeth. 4. The character of the food masticated and of other substances chewed

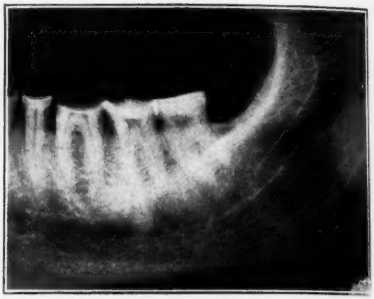

Fig. 11.—Radiographic view of denture shown in Figures 9 and 10. Note the partial extrusion of the roots of the first molar, which now appear shorter than those of the adjacent teeth. The alveolar septums are all intact except the one mesially to the first molar, which has been affected by food impaction, owing to the breaking down of the occlusal wall of a mesial cavity in that tooth. When a root surface is exposed interproximally, it is very susceptible to caries, not alone through occlusal food impaction but also through an unhygienic condition. The softer root surface is more easily affected by the latter than is the denser enamel surface of the crown. The interproximal caries here shown was probably not caused by food impaction.

habitually, vocationally or for other utilitarian purposes. 5. The amount of chewing done—either because of quantity of food consumed or the thoroughness with which it is masticated. 6. The concentration of mastication at one area. 7. Faulty nutrition or metabolism, affecting the rapidity of occlusal wear.

TYPES OF OCCLUSAL WEAR

1. *Mesiodistal Planing.* (Fig. 4.) By this, I refer to the characteristic wear of the mesial and distal inclines of the occlusal surface into oblique, more or less straight, facets. In this type, the loss of the marginal ridges and grooves usually tends to produce food impaction in spite of the apparently close contacts. In office practice, I have often eliminated food impaction here by forming new marginal grooves with a stone and by reducing the circumference of the facets. Failure to reproduce marginal ridges and grooves in mesioclusal or distoclusal restorations in a mouth of this type invites food impaction.

2. *Horizontal Wear (Mesiodistally).* In this type, the obliteration of the marginal ridges and grooves does not necessarily result in food impaction; therefore, it is apt to be less injurious than the one previously mentioned. (Figs. 5-11.) In fact, it seems that, with the wearing away of the cusps, these ridges and grooves are no longer required for their original function. It is also interesting to note on many of the skulls, that, in this type of wear, loss of the occlusal embrasure does not in itself seem to affect, necessarily, the interdental alveolar septum in jaws otherwise not affected pathologically.

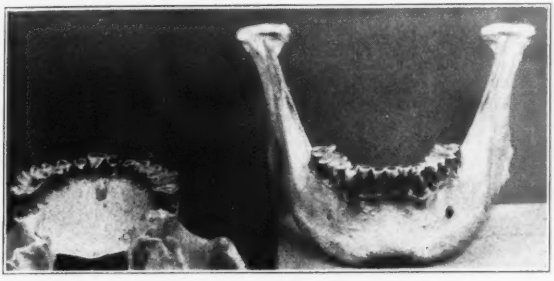

Fig. 12.—Extreme oblique wear with the occlusal inclines in the normal direction.

3. *Oblique Wear.* (Fig. 12.) The wearing away of the occlusal surfaces of the posterior teeth with a buccolingual incline, facing bucally in the lower and lingually in the upper, may be considered the normal in advanced occlusal wear because of its frequent occurrence. It is caused, evidently, by the normal buccolingual relationship between the opposing teeth and by the normal limitation of the range of lateral oscillation of the mandible. This type of wear may be explained as follows: Normally, the palatal cusps of the upper teeth and the buccal cusps of

the lower (referred to in this paper as centric cusps), because of the relation of each to the occlusal fossa of the opposing teeth, are the working cusps of their respective teeth and thus tend to get greater wear than the other cusps (referred to as eccentric cusps). On the other hand, the eccentric cusps, being partly outside the limit of the oscillating radius of the mandible, receive much less and slower wear than the centric cusps, and so they may still be

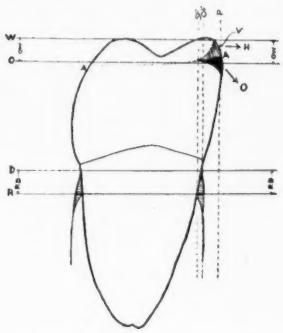

Fig. 13.—Diagrammatic drawing showing buccolingual view of the lower first molar. Originally, the height of the cusps is at *W*, that of the buccal cusp being inside the alveolar rim (*D*), while that of the lingual cusp is approximately directly above the lingual alveolar border (*OF-D*). Marked occlusal wear (*OW*) may be accompanied by a partial extrusion of the tooth out of the alveolus (*RD*). Either this or the root may have been denuded of alveolar plate to the same extent at this stage of occlusal wear through atrophy or otherwise. The result accruing from these changes is a marked leverage produced by the new high point (*P*) of the lingual cusp standing far beyond the new fulcrum (*SF*), which is now inside the original fulcrum (*OF*). Leverage may further be accentuated in this case through the decrease in length of the part of the root remaining imbedded in the alveolus. This leverage may easily be reduced to a minimum by grinding off the vertical section (*V*) and the darker triangular section immediately beneath it in the diagram. This brings the height of the cusp to its original relative position, approximately opposite the alveolar border at *OF*.

Fig. 14.—The first permanent molar in this illustration is an example of leverage produced by occlusal wear as described in Figure 13.

in evidence after the centric have entirely disappeared, with their centric sides either vertical or oblique. Where

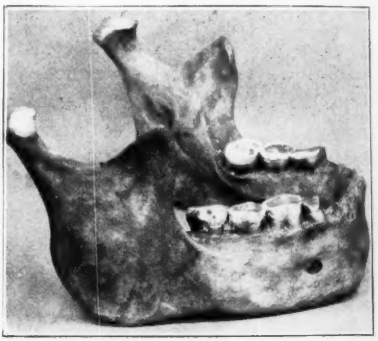

Fig. 15.—Lingual view of mandible in Figure 14, showing no evidence of alveolar absorption, notwithstanding leverage.

this type of wear becomes far advanced, the highest point of the eccentric cusp is carried considerably outside the alveo-

lar rim or fulcrum on that side. It is obvious that this final arrangement must result in severe leverage especially in the lower first molar during mastication of hard food. Yet a conscientious examination of the alveolar border on the lingual side of this tooth, in skulls, discloses the fact that, unless there are evidences of alveolar destruction about other parts of the dental apparatus, the bone here is apt to be intact on both the crest and the pericemental side of the

Fig. 16.—Skull of Australian aboriginal, showing extreme labial incline of the anterior teeth. This should result in great leverage.

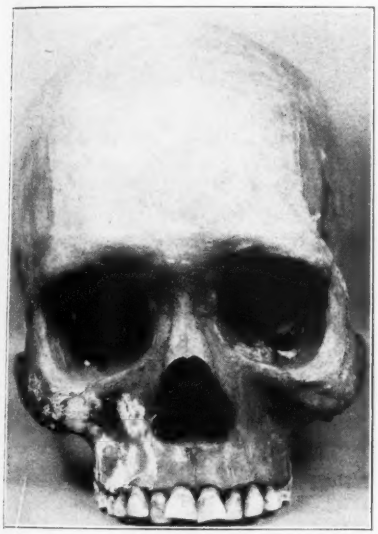

Fig. 17.—Anterior view of skull in Figure 16, showing that, in spite of the leverage, the alveolar border is intact.

Fig. 18.—View of skull showing upper left temporary cuspid retained in an adult. This tooth has extruded out of the alveolar socket because of the greater size of the permanent teeth and because of its own marked occlusal wear. The change thus produced in the proportion between the power arm and the weight arm, should result in leverage, yet no alveolar destruction is evident.

Fig. 19.—Radiographic view of cuspid shown in Figure 18.

alveolar plate. This would seem to indicate that leverage, unless very extreme, will not cause periodontoclasia except when an underlying, probably systemic, causative factor coexists. Apropos of this statement, illustrations are shown, among others, of several distinctly differ-

Fig. 20.—Skull of Peruvian child between 8 and 9 years of age. The central crowns are very large in proportion to the roots as shown in the radiograms, yet there seems to be no evidence of alveolar destruction due to leverage.

ent types of marked leverage, which, nevertheless, betray no evidence of alveoloclasia. (Figs. 13-21.) This is not intended to belittle the important rôle that traumatic leverage plays as a potential etiologic factor in periodontoclasia. In fact, it might be advantageous to reduce such leverage as a preventive step during health, and to correct it, whenever possible, in disease, as one would traumatic occlusion. The oblique buccolingual wear tends to assume a reverse direction where the lower posterior teeth stand bucally to the uppers, i. e., the incline faces lingually in the lower and bucally in the upper. (Fig. 22.) In this case, what I called the eccentric cusps in the normal arrangement are now the centric, and are accordingly

Fig. 21.—Skull showing characteristic long necks of the deciduous anterior teeth, which invite leverage; yet no alveoloclasia is evident.

worn down first. This, of course, is normal in relation to the reverse anatomic conditions, though abnormal, generally speaking. When the opposing teeth are more nearly in cusp to cusp occlusion, or the mandible takes on a greater radius of lateral oscillation, extreme occlusal wear tends to become horizontal buccolingually.

OCCLUSAL WEAR IN RELATION TO TRAUMATIC OCCLUSION

It is a well known fact that the mouth with a perfect occlusal arrange-

ment is extremely rare. An inharmonious occlusal relationship, to a greater or less extent, is found in practically every mouth during the earlier years. However, with use, the high spots may wear themselves down into a harmonious arrangement without having established permanent symptoms of periodontoclasia. Other instances of such beneficial occlusal wear are: (1) the correction of the inharmonious occlusion caused by a mesiodistal drifting due to the nonreplacement of an extracted tooth and (2) restorations of occlusal surfaces with gold, especially of softer alloys, eventually conforming to the normal occlusion. Although occlusal wear may abort or prevent the effects of an existing traumatic occlusion, it may, on the other hand, bring about traumatic occlusion. The posterior teeth are so built and occlude with their opponents in such a way that they limit the degree of approximation between the mandible and maxilla. The anteriors may assist in this respect, but to a comparatively secondary degree. When, through excessive use, the posterior teeth wear down more rapidly than the anteriors, the latter take on an occlusal strain even in centric position. Traumatic occlusion may similarly be visited on the anterior teeth either through mesiodistal drifting of the posteriors caused by the extraction of individual teeth, or through the absence of many or all of the posteriors. Traumatic occlusion thus produced on the anterior teeth is often more pronounced when an individual incisor tooth stands in torsion and is the only one to strike in bite-to-bite fashion. The same may be said of the lower incisors, abruptly stopped by a horizontal trough worn out on the palatal side of the uppers.

Fig. 22.—Skull in which the lower posterior teeth stand buccally to the uppers. This results in a reversal of the buccal-lingual direction of the occlusal wear.

OCCLUSAL WEAR IN RELATION TO NONINFECTIOUS ROOT EXPOSURE

Among the various deviations from the normal in the mouth is the noninfectious root exposure, a condition often improperly diagnosed as of pathologic origin. This subject has been discussed in a previous paper, but it bears repetition. Although extra-oral agencies, such as tooth brushing, etc., may often

cause such a condition, it happens occasionally that the partial extrusion of a tooth out of the alveolar socket is alone responsible. This extrusion may result from a congenital lack of occlusion, or the absence of an opposing tooth, or from excessive occlusal wear. An outstanding instance of root exposure due to excessive occlusal wear is that of the palatal root of the upper first molar. This tooth is several years older than any other tooth in the posterior part of the mouth and must necessarily become worn down proportionately. In addition, it is practically the center of the masticating area of the dental arch. Because its palatal cusp has received greater and longer wear generally than that of any other tooth, this molar must of necessity drop down to its opponent. This in itself might result in a certain amount of cervical denudation. But the extreme incline or flare of the palatal root so often present in this tooth tends to carry with it the gingiva and the thin alveolar plate, with the result that both are soon absorbed physiologically by the pressure brought against them, by food and the tongue, during mastication. The cervical part of the root is thus exposed. (Fig. 23.)

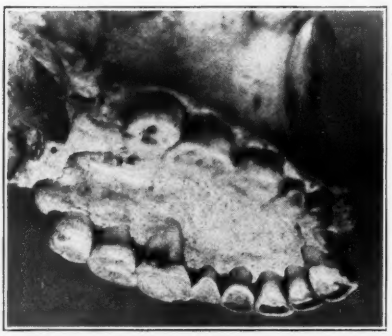

Fig. 23.—Exposure of the palatal root of the upper first molar, caused by extrusion of the tooth out of its alveolar socket, because of extreme occlusal wear. The alveolar process in this skull is apparently in perfect condition.

The condition of the lower central incisor also may be referred to as an outstanding example of improper diagnosis in this regard. Under certain conditions, this tooth, wearing off faster than the other anterior teeth, is therefore being constantly "fed" up to its opponent in proportion to the amount of wear—like the lead in an "Eversharp" pencil. As a result, the neck is soon exposed to view, and eventually the root surface. A differential diagnosis of the nonpathologic root exposure

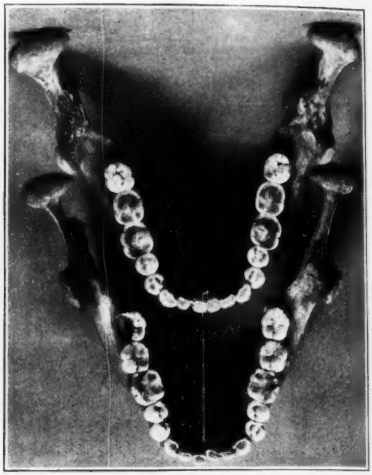

Fig. 24.—Mandible showing greater occlusal wear on the central than on the lateral incisors. This is occasionally the result of a certain type of anatomic relationship between the central incisors and their opponents.

of this tooth may be easily made by means of the following facts: 1. The labiolingual diameter of the occlusal surface which now displaces the incisal margin on the central is greater than that of the lateral; in fact, this surface may even have become square, while that of the lateral still remains oblong. (Figs. 2 and 24.) 2. The root of the central may appear much shorter radiographically than that of the lateral. 3. Aside from these, no abnormal or pathologic symptoms may be present.

In a generally healthy individual, the above described central may continue extruding until a great part of the crown is worn off without showing any evidence of actual periodontal disease. However, should this process of extrusion be accompanied by a systemic condition, which, to my mind, usually underlies periodontoclasia, this tooth is apt to be among the first affected pathologically, for the following reasons: The central incisor has the smallest root in the mandible, and, when normal, it has, accordingly, a short narrow incisal edge which, through its contiguity with the edges of the other anterior teeth, takes on a minimum of periodontal strain during function. When this tooth is partly extruded on account of marked incisal wear, the following physical changes tend to increase the periodontal strain: 1. The presence of a broad occlusal surface instead of a thin incisal edge. 2. Shortening of the portion of the root remaining imbedded in the socket on account of the incisal wear, the leverage of that tooth being increased proportionately. 3. The partial extrusion out of the alveolar socket, resulting in a lessened contact surface between the root and the process. This results in an increased pressure inversely proportionate to the decreased alveolar and pericemental support.

SUMMARY

1. Mesiodistal planing of the occlusal surfaces by masticating wear tends to food impaction especially if the marginal ridges and grooves have been obliterated.

2. In horizontal occlusal wear, obliteration of these protective anatomic features does not seem to produce interproximal food impaction, the alveolar septums, apparently, remaining unaffected.

3. This is also true regarding the obliteration of the occlusal embrasure.

4. The last two statements, however, should not be misconstrued as minimizing the importance of replacing these anatomic features in the rounding out of contour in proximal restorations.

5. Oblique occlusal wear invites leverage which may become an important local etiologic factor in periodontoclasia and has to be reckoned with in treatment.

6. A close examination of the skulls discloses the fact that leverage, unless very extreme, will not by itself produce periodontoclasia. This fact is proved repeatedly in many instances of leverage produced by different causes as shown in the accompanying photographs.

7. Occlusal wear may be a means of obliterating traumatic occlusion in some instances and of producing it in others, directly or indirectly.

8. Excessive occlusal wear may result in extrusion of the tooth out of the

alveolar process until part of the root surface is exposed to view, creating the optical illusion of a gingival recession.

I wish to take this opportunity to express my appreciation of the privileges extended by the officers of the American Museum of Natural History and to thank them for their kind cooperation.

I also wish to acknowledge the able assistance of Dr. Samuel M. Getzoff of New York in making the radiograms of the dry specimens.

730 Fifth Avenue.

DISCUSSION

Austin F. James, Chicago, Ill.: As the younger men come into the profession, with their better preliminary training, there is hope of approaching this subject with greater and more scientific understanding. Within the last few years, it is being approached from the engineering standpoint, as in Drs. Anderson and McMillan's study of bone and the positions of the teeth, and in Dr. M. M. House's studies in the mechanics of occlusion. In fact, the subject is being approached from so many standpoints that the old time practitioner realizes he is being surrounded and overwhelmed with many things that he knows little about. It is my opinion that we have been doing too much grinding of cusps with stones for relief of wedging forces, and in the future we must make greater use of orthodontic appliances as a means of preventing trauma and as a means of correction. When one or more teeth have been lost in the arch and the adjacent teeth have begun to tip into the space, we should use the orthodontic appliances to replace them and follow this procedure by properly restoring the lost tooth or teeth. In the sixth item of Dr. Hirschfeld's summary he says that leverage, unless very extreme, will not of itself cause periodontoclasia. This is true in the skulls of primitive races among whom heavy mastication was used from childhood, because the heavy usage did build up tissue cell resistance and strengthen the supporting structures. But in modern existence, where we eat softer foods, there is not the building up of resistance in supporting structures and we do find alveolar destruction in the mouth of otherwise healthy individuals. It has been my observation that in the people of today we may build up tissue cell resistance by the use of proper massage and stimulation with the toothbrush.

Arthur H. Merritt, New York City: It has been my privilege to be associated with Dr. Hirschfeld in this most interesting, not to say fascinating, study of the skulls in the American Museum of Natural History. These mute witnesses of the past, who lived their lives under conditions quite unlike those of the present, shed a flood of light on some of the problems which civilization has brought and with which we of this generation are face to face. Great credit is due to Dr. Hirschfeld for his most careful and painstaking observations. He has gone back to those records, not written by the erring hand of man, but by Nature herself—records which are open only to those who have eyes to see and ears to hear—and with the spirit of the true investigator, freely gives us the fruit of his investigations. It is only thus that progress is made, and fortunate indeed is that profession which numbers among its members those who are willing to make such sacrifices. Perhaps the most impressive observations noted in this study, has been the tremendous strain imposed on the teeth of these barbarians as manifested in occlusal wear, often to the extent of complete obliteration of cusps, and, in some instance, exposure and death of the pulp, without any breaking down of alveolar support. And in addition to this strain, the mouths, in many instances, must have been filthy in the extreme, with tartar abundant, and every element making for gingival irritation was present. Yet the teeth remained firm in their sockets, with no evidence of disease in their osseous support. This would seem to indicate that that phenomenon which has come to be known as traumatic occlusion, and to which is assigned such an important rôle in the etiology of periodontoclasia, is in reality an occlusion which does not traumatize under normal conditions. Dr. Hirschfeld's observation on this point is that it "tends to indicate that leverage, unless very extreme, will not cause periodontoclasia except where an underlying systemic causative factor coexists." The question which naturally sug-

gests itself in this connection is: What was there in those prehistoric races that made for periodontal health that is lacking in the civilized races of the present? In the first place, they had, with few exceptions, normal occlusion. Their teeth were well formed and so related to each other, and to those of the opposing jaw, that they did the maximum of work with a minimum of strain. They were also not subject to dental caries. This meant that they retained their teeth throughout life, so that the strain imposed on them was borne by thirty-two teeth, all in normal occlusion, instead of, as is so often the case in the present, by a smaller number, with the accompanying changes in occlusal relations and added strain, which always follows tooth loss. Given these conditions of normal occlusion and full complement of teeth, plus a diet of hard and fibrous foods, it naturally followed that vigorous use was translated into well-nourished and well-developed jaws, which were highly resistant to disease. And when we reflect on how different this record of the past is as written by the hand of Nature on these skeletal remains of our barbaric ancestors, and compare it with the conditions prevailing in the present, we have the answer to our inquiry. The conditions are not comparable. Perhaps the factor that is most important in this changed condition of the present, and out of which all the others flow as a natural consequence, is relative disuse. Failure to use our jaws and teeth as did those races of the past has resulted in poorly nourished tissues, undeveloped jaws, irregular teeth and a greater susceptibility to disease. This, plus heredity and changed environment, will explain why we cannot be compared, from a dental standpoint, with those living in the past, and why we cannot hope to enjoy their relative immunity to dental disease.

Dr. Hirschfeld (closing): If it were not for the practical experience of the "old time practitioner" referred to by Dr. James, the younger men would probably go far afield occasionally in their new theories and ideas. No doubt we have to make great allowances for the difference between the aboriginies and civilized man both in respect to periodontal development and the fact that the masticating apparatus in most mouths today is disarranged with traumatizing results, through extractions. Then, again, we of today have to contend with dental restorations which do not fit in with nature's scheme of function and protection of the periodontium. I fear that Dr. Merritt is giving me too much credit for my efforts in my work at the museum. The material there is rich in information and is available to anyone who is genuinely interested.

IMPACTED TEETH IN THEIR RELATION TO PSYCHONEUROSES*

By EMIL L. AISON, D.D.S., Chicago, Illinois

THE study of human progress shows that every forward movement meets with some reaction. Sometimes, it is sharp, at other times, mild, depending on the degree of departure from the traditions of old. Frequently, a new thought causes a reverberation as from a vast pendulous sweep. Yet progress continues. It is an established fact that many scientific discoveries, which later proved to be a blessing to mankind, have been at first the object of not only painstaking scrutiny, but also most unjust criticism. Yet theories and ideas must withstand the test of time and adversity before they can be properly evaluated. Thus may be explained the reluctance on the part of some members of both the medical and the dental profession to accept the validity of the claims that there is an important relationship between dental disorders and certain forms of insanity.

Insanity is a general term applied to many types and varieties of nervous and mental disease. Sometimes, the disease is so severe as to produce marked disorders of conduct in the affected subject. In some forms, the trouble is in the nature of an intellectual anomaly, which renders impossible the adaptation of the subject to his normal surroundings. In still other types, the conduct of the patient may appear rational.

The classification of different types of mental disorders or elaboration on their many complex symptoms is not within the province of this paper. It is sufficient here to say that both type classification and symptom interpretation have undergone numerous modifications since types of mental disease have begun to be named according to clinical and laboratory findings by authorities and schools of psychiatry the world over. The principal object of this presentation is to correlate the information on the subject of the influence of impacted teeth on the mental state on the basis of the experience of others, with that of my own, especially that experience which I find to be in harmony with my own observations in a number of cases.

For a clearer conception of their etiologic factors, it is well to divide mental disease, into two great groups. Group 1 is composed of types of insanity caused primarily by actual pathologic changes in the cellular structure of the brain itself, as in hereditary or acquired

*Read before the Section on Oral Surgery, Exodontia and Anesthesia at the Sixty-Seventh Annual Session of the American Dental Association, Louisville, Ky., Sept. 23, 1925.

syphilis, chronic alcoholism, hereditary predisposition augmented by disease, endocrine imbalance or dysfunction, paralysis and senility. In Group 2 are included types of nervous manifestations brought about by maladaptation, emotional shock, continued severe strain of all kinds, irritations secondary to many different diseases, privation, infections and intoxications. Mental disorders resulting from conditions of the second group, and known as functional psychoses or neuroses, are types of nervous abnormalities in which there is no actual organic degeneration of the central nervous system.

Whatever their cause, the purpose of modern psychiatry is not only to care for the sufferer in order to protect the community from him and himself from the evil consequences of his own conduct: its greater aim is to recognize and remove those obscure yet potent factors which are responsible for many nervous and mental aberrations. Those factors, when understood, can, in many instances, be successfully managed and the patient can be restored to normal mental and physical health and useful citizenship before a hopeless mental invalidism develops. It is the second group in which we as dentists are vitally interested, for here our opportunity for service is great.

Among the many causes of mental and nervous disturbances not directly associated with demonstrable brain lesions, the presence of diseased and impacted teeth no doubt plays an important rôle That mental symptoms arise from remote irritations is now well known. The relation of focal and systemic sepsis to functional mental disorders is no longer vague. The relation between diseases and anomalies of the teeth and morbid nerve conditions, especially of the neuralgic type, has long been understood. Studies have also been made by Down,[1] Talbot,[2] Case[3] and others of the peculiar anatomic deviations of the oral and dental tissues in the mentally subnormal and the insane. However, dental irritation as a cause of any form of mental aberration was not seriously thought of until the investigations of Kron,[4] Upson,[5] Lodge[6] and Stephen, Sorapure[7] and Taylor[8] attracted the attention of the medical and dental professions. Subsequent experience by

1. Down, Langdon: On the Relation of the Teeth and Mouth to Mental Development. Trans. Odontological Society, Great Britain, Vol. 4, 1872.

2. Talbot, E. S.: History of Deformed Vaults. Dent. Cosmos, 35: 1209 (Nov.) 1893.

3. Case, I.: The Correlation Between Mental Defects and Anomalies of the Hard Palate. Am. J. Insanity, 1918-19.

4. Kron, Herman: Nervenkrankheiten in ihren Beziehungen zu Zahn und Mundleiden. L. Marcus Verlagsbuchhandlung, Berlin, 1907.

5. Upson, Henry S.: Dementia Praecox Caused by Dental Infection. Monthly Encyclopedia and Med. Bull., Nov. 1909. Upson, Henry S.: Insanity Caused by Painless Dental Disease, Dent. Cosmos, Vol. 52: 526 (May) 1910.

6. Lodge, E. B.: Serious Mental Disturbances Due to Teeth. Dent. Summary, 28: 177 (March) 1921.

7. Sorapure, V. E.: A Note on the Treatment of Habit Spasms. Dent. Cosmos, 57: 266 (March) 1915.

8. Taylor, M. J.: Reflex Disturbances Due to Faulty Development of Teeth. Trans. Am. Climat. and Clinical Assn. Philadelphia, 1917.

Cotton,[9] Walker,[10] Sawyer,[11] Young,[12] Ackland[13] and others has corroborated the earlier findings. These men demonstrated that in certain special cases dental diseases and malformations, some not easily found or recognized, are not only capable of causing reflex mental conditions, such as mania, melancholia, paranoid symptoms, dementia precox and numerous behavior manifestations, but that when promptly removed there is a quick, and in some cases almost a spontaneous, recovery. The cases here cited are typical of those under consideration.

REPORT OF CASES

CASE 1.—W. B. aged 23, an art student, bright mentally and active in athletics, well developed physically and usually in good health, and weighing 152 pounds, with a history of measles at the age of 2 and a family history showing no insanity, syphilis or alcoholism, and who was never before irritable or sensitive, during September and October, 1916 complained of slight pain in the region of the angle of the lower jaw on the right side. Dec. 17, 1916, he again complained of pain in the same region, this time greater in intensity. The next day he became very excitable without any apparent cause, and later, under some trivial pretext, had a violent quarrel with his brother. His excitability rapidly increased. December 19, he became much worse, tearing and breaking up anything within reach, using profane language and striking at members of the family who attempted to calm him. He refused food and drink and did not sleep; talked disconnectedly, swore and gesticulated incessantly. This state continued, the patient being for the greater portion of the time in an agitated and hyperkinetic condition. A diagnosis of acute mania was made by the attending psychiatrist, who recommended a dental examination. December 24, an oral and dental examination was made, at which time the presence of an impacted mandibular third molar tooth was discovered on the right side. The tooth was imbedded in bone in a horizontal position, the crown pressing on the distal surface of the second molar. December 28, after a preliminary dose of morphin, the tooth was extracted under general anesthesia. The patient was kept quiet with opiates for the following thirty-six hours. December 30 to January 8, he was quiet but in a condition of great exhaustion. Loss of weight was very evident. January 11, he was much improved, completely calm and appeared rational. There was no recurrence of the attack, and the patient was discharged as cured, January 15.

CASE 2.—R. C., first class private in the medical department, American, aged 24, a chiropractic student up to time he entered the military service in October, 1917, egotistic and erratic, gave the following history: His father and mother were living and well. At the age of 8, he had an attack of acute otitis media, which was followed by mastoiditis, for which he was operated on successfully. He did not get along well with the other members of his detachment, by whom he was frequently chided and ridiculed for his air of superiority. He was not a willing soldier, and reported frequently on sick call. He was twice disciplined by a detachment commander for insubordination. March 4, he was sentenced to short term by summary court-martial for the same offense. March 6, he reported on sick call, but the medical officer who examined him ordered him back to confinement, not having found the prisoner ill. March 7, he again reported on sick call and was again returned as not being ill.

9. Cotton, H. A.: The Defective, Delinquent, and Insane. Princeton Univ. Press, 1921.

10. Walker, C. H.: Reflex Neuroses from Teeth. Texas Dent. J., 1921.

11. Sawyer, C. W.: Psychoses Accompanying Extraction of Teeth. Ohio State M. J., 17: 545 (Aug.) 1921.

12. Young, G. A.: Focal Infection in Neuropsychiatry. Nebraska M. J., 8: 307 (Sept.) 1923.

13. Ackland, W. R.: Focal Sepsis of Dental Origin Causing Mental Impairment. Brit. Med. J., 2: 12 (July 4) 1925.

March 8, he again reported sick, this time complaining of pain about the teeth, and was sent to the dental clinic for examination. Information that the patient was possibly malingering was also communicated. The dental examination did not disclose any obvious trouble, and after minor treatment the patient was dismissed. March 9, he suddenly became very violent. His mental condition became one of complete confusion and he seemed to be unconscious of his surroundings. This condition continued for several days, augmented by delirium, visual and auditory hallucinations and a temperature varying between 101.6 and 102.4, and was accompanied by great emaciation. Opiates would keep the patient quiet for a time. Forced feeding became necessary. March 15, after a consultation between medical, dental and psychiatric staffs, several large radiograms were taken of the jaws and contiguous structures. These disclosed an impacted third mandibular molar tooth on the right side, with a well defined abscess under the coronal portion. A diagnosis of acute delirious mania induced by dental disease was made. March 16, the impacted tooth was removed under general anesthesia. The operation was followed by a violent reaction, fever, leukocytosis and debility. After several days, the patient began to improve. March 29, he was completely conscious of his surroundings. The symptoms gradually disappeared, and temperature and pulse returned to normal. Convalescence continued and, May 1, he was discharged as cured.

Case 3.—E. H. G., a woman, aged 30, born in Ireland, a clerk, single, religious and of happy disposition, with a history of no previous serious illness, and a negative family history as to insanity, syphilis or alcoholism, in February, 1918, began to complain of persecution on the part of co-workers in the place of her employment. Later, she accused members of her family of the same thing. About that time, her family noticed marked changes in her behavior. Instead of her usual demonstrativeness, she showed no interest in those surrounding her and sought complete seclusion, complaining that people wished to do her harm. She was in a state of great apprehension and depression, marked by restlessness, loss of appetite and insomnia, which were followed by a general breakdown. In May, 1918, she was much worse, and she became completely estranged from her family and others, and suffered from vivid hallucinations and delusions. A deep silence for many days or weeks at a time, or conversation with fantastic objects were characteristics of her behavior. A previous diagnosis of manic depressive psychosis made by a psychiatrist was changed to dementia precox. The patient spent a greater part of 1918 and part of 1919 in an institution and in September, 1919, was taken home showing no improvement. Oct. 12, 1919, a swelling developed on the left side of the upper jaw, which was supposed to have been edentulous for eight years. An oral and radiographic examination disclosed the presence of two impacted unerupted cuspid teeth on the right and left sides of the maxilla, respectively, with a large abscess about the left. The removal of these teeth was advised and, October 20, they were extracted under general anesthesia. After two weeks, the patient began to show evidence of mental improvement. In December, she became communicative and, for the first time in eighteen months, realized her condition. In January, 1920, her condition had returned to normal. She was again examined by a neuropsychiatrist in 1922, at which time no evidence of mental abnormality was disclosed.

Case 4.—S. T., aged 36, one of twin brothers (the other brother living) an upholsterer, American, head of a family of five, temperate and a steady worker, had been in good health but was nervous and temperamental. The family history was negative. Nov. 4, 1918, the patient complained of a disagreeable copper-like taste in his mouth and expressed fear that he swallowed a tack. A few days later, he became more apprehensive and said that he was poisoned. Later, he confided to his brother that his wife wanted to kill him. His restlessness, fear and insomnia increased, and he finally refused food, saying that it was poisoned. On the night of November 12, he awakened with outcries that he was being attacked

with spears. A diagnosis of delusional melancholia was made by the attending psychiatrist. The condition of patient became progressively worse, and he sought complete seclusion, fearing everybody. He was disturbed by frequent hallucinations (auditory and visual) and "these terrible people are here again to take my life" were his daily outbursts. He lost weight and, by May 1, 1919, was reduced to 110 pounds from a usual weight of 160 pounds. In May, 1919, he was taken to the country. Here, he attempted suicide in June, but was saved and placed in an institution for several months. In January, 1920, he was taken home, having shown no improvement excepting for periods of quiet reserve during which he would say that he knew something terrible would happen tomorrow. Jan. 10, 1920, a dental examination was made. At this time, the patient was emaciated, with tongue coated and rapid pulse, and he seemed very apprehensive. A radiographic examination disclosed an impacted second bicuspid tooth on the left side of the mandible. Extraction of this tooth, together with a badly abscessed adjoining first molar, was recommended. January 12, the teeth were removed under general anesthesia. The patient soon began to show signs of general improvement, eating and sleeping well. Convalescence continued and, by the middle of February, he understood his surroundings, and talked rationally although infrequently. Early in March, he remarked that he was well and was going to stay well. May 1, 1920, he returned to work for the first time in nearly one and one-half years. When last seen in May, 1925, he appeared well and rational.

CASE 5.—G. S., aged 43, a woman of high social standing and fine cultural attainments, a constant reader, including works on medical subjects in her reading, the mother of two children, very busy with home and social affairs, a nervous type, gave a history of no previous serious illness. The family history was negative as to insanity, although others in the family were "temperamental." Early in 1922, she began to complain of ill health, insomnia, loss of appetite and pains in various parts of the body at different times. She also became extremely talkative, restless and obsessed with great fear of impending terrible disease. The family physician was unable to detect any organic trouble and ordered a complete rest. The patient, however, became worse, talked incessantly and complained of burning pains in different parts of the body every day, at the same time calling the attention of those around her to imaginary inflammations and eruptions on different parts of her body. Any disagreement as to the symptoms on the part of physicians or members of the family brought forth violent outbursts of temper, followed by hysterical crying, lasting for hours. In May, 1922, the patient was taken to an institution. Here she variously believed herself afflicted with erysipelas, pharyngitis, pyorrhea, leukemia, nephritis, myocarditis and leprosy, mentioning the different diseases by name at different times. Soon, however, the predominating complaint was leprosy. The husband was informed by the psychiatrist last in charge that the patient was hopelessly insane, suffering from dementia precox, and incurable. In March, 1923, the family dentist, who was also a relative of the patient, advised that a study of the condition of her teeth be made and referred her to me. A roentgen-ray examination disclosed the presence of an impacted abscessed right upper cuspid and impacted right mandibular third molar. There were no local symptoms and up to the time the patient finally learned of the dental finding, she did not complain of toothache, although previously she would frequently say that she was suffering from pyorrhea and that pus was constantly oozing from the gums. During this examination the patient talked incessantly, complained bitterly of her troubles, mainly leprosy, and related in great detail the ill treatment she received at the institution she was in, the stupidity of the doctors and the unsympathetic treatment from the family. She was particularly incensed at the neurologists, whom she said she did not need in the first place and who did not understand her case anyway. The impacted abscessed cuspid was extracted, March 16, 1923, but no great change in the patient's mental condition was noticeable. Two weeks later, the impacted mandibular molar was removed. The pa-

tient soon regained her normal mental balance. In the early part of May, 1923, she was completely well. Since her recovery, she has taken up and completed special university work and when last heard from, in July of this year, was perfectly normal.

CONCLUSIONS

While extreme caution and exercise of judgment are imperative in the treatment of this type of cases, lest other etiologic factors be overlooked in one's enthusiasm, experience clearly indicates that infection and irritation of dental origin are capable of producing, through both the vasculolymphatic system and the intricate ramifications of the nerve supply, serious mental and nervous phenomena, especially in those individuals who have a neuropathic or psychopathic diathesis. The conditions produced vary in character from slight impairment of the intellect and the group of symptoms which come under the terms "neurasthenia" and "hypochondriasis" to the most severe manifestations of unsoundness of mind accompanied by suicidal impulse, delusions, fantasies and complete cessation of contact between one's mental life and its surroundings. However, we must never lose sight of the fact not only that many of the so-called functional psychoses and neuroses are caused by conditions incident to various periods of one's life and pathologic changes other than dental, but also that there are periods of remission during which the patient will appear normal, and that many patients recover with or without treatment after the disease runs its course; also that there are many individuals with impacted unerupted and diseased teeth who show no signs of mental disturbance. The latter fact should be viewed with the thought in mind that the degree of immunity to infection as well as tolerance to irritation varies in different individuals; a phenomenon which constitutes a great influence for good or evil in this, as in other, conditions.

Another important feature is that reflex nervous conditions of dental etiology sometime present no local symptoms and, as a result, the dental aspect is not considered by physician, psychiatrist or dentist. At the same time, the nervous and mental manifestations are so simulating and frequently present a clinical picture so characteristic of the many well known grave mental abnormalities, as often to cause a mistaken diagnosis, and the condition of the patient is not infrequently considered hopeless. These are critical situations which place a great responsibility on the diagnostician and require the closest and broadest study of the problem from every possible angle. A searching dental and oral examination should, therefore, be a matter of routine in psychiatric practice.

It is not unusual to see patients who are suffering from acute mania, melancholia, hypochondria, the different phobias, compulsions, inadequacy and insomnia recover completely after impacted unerupted teeth are removed, together perhaps, with other coexistent disease. The rapid recovery of patients under similar treatment who were regarded as hopelessly insane clears up a more distressing clinical puzzle. We are inclined to accept the interpretation that both the findings and the prognosis in these cases are indicative of purely peripheral irritation, with or without infection.

True, there will be many disappoint-

ing failures if an attempt is made to cure all mental cases through extraction of teeth. Such a procedure would not only be hopeless, but also would bring discredit on the profession; for, as has already been pointed out, dental anomalies and diseases are only one of the causes of mental disturbances.

15 East Washington Street.

DISCUSSION

F. B. Moorehead, Chicago, Ill.: Submerged teeth, whether impacted or not, should not be removed merely because they are submerged or impacted, or both. Any submerged or impacted tooth which is involved in an infection should be removed, and any submerged or impacted tooth which is producing either direct or indirect symptoms should also be removed. It is, of course, in the latter type of case that one is called on to make a discriminating decision, and it is usually difficult and frequently impossible to make any determination except a tentative one. It is perfectly true that submerged teeth do cause more or less serious disturbances, some of them local, and some of them general, in character. It is not unusual for a patient to suffer from a localized headache or pain in the temple region, or pain in the ear, produced by a submerged third molar. On the other hand, patients suffering from extreme nervousness are frequently relieved after the removal of submerged teeth. All such patients should be critically examined by a competent neurologist, and every other factor ruled out, before any determination is reached with reference to submerged teeth. I think that the removal of these teeth, merely because they have not erupted is a bad practice. The operation is frequently rather difficult, and the convalescence protracted and painful. In all cases, the patient should understand that the removal of the tooth is not a definite proof of relief. Moreover, the removal of a tooth may be coincident with the disappearance of nervous symptoms and should not be construed as evidence of cause.

W. I. Jones, Columbus, Ohio: Although I do not know as much about psychoneurosis as I do about the removal of impacted teeth, out of a large experience I wish to relate a case in my own practice that impels me to believe that sometimes psychiatrists and exodontists attach more blame to impacted teeth than they really deserve. That they are capable of producing great pain and discomfort and often are the foci of infection and mental neuroses is a fact too well authenticated to admit of any doubt; yet all impacted third molars do not bring their owners to asylums for the insane. About eighteen months ago, a young woman was brought to me by her elder sister, who hastened to tell me in private and, before introducing me to the patient, of the sad plight of her sister, her sullen disposition, her many hallucinations and attempts at suicide, at the same time presenting me with a letter from her family physician in which he stated that the patient was in perfect physical health and well nourished; that she was neurotic, and that he felt this was due to the presence of four impacted third molars, which in his opinion, should be removed. The patient did not complain of any discomfort and, on examination, exhibited none of the signs of an inflammatory process, such as heat, redness, pain or swelling. The patient was anesthetized and the teeth were removed. No pathologic condition was found. I was convinced that the impacted teeth were not the sole cause of her mental condition and I determined to find out if possible its cause. After she had recovered from the anesthesia, and with no one else present, I said to her, "These teeth have undoubtedly been the cause of a great deal of your trouble and it is well that they are out. You will without any doubt improve rapidly, but your physician expects me not only to extract your teeth, but also to help him to cure you. Now there is something else on your mind and I want you to tell me what it is." After much persuasion, she told a story of great domestic infelicity extending over a period of years. Some wholesome advice led to a reconciliation with her husband, and several months ago she returned to see me, healthy and happy. I ask, was her trouble caused by impacted teeth or domestic infelicity?

Stanley L. Rich, Nashville, Tenn.: In my somewhat limited experience in this line of work, I have had a few cases in which the removal of impacted teeth has given such marked relief from psychoneurotic manifestations that I have become particularly interested in the subject. In reviewing the

literature on this subject we find hundreds of well authenticated cases in which prompt relief from psychopathic symptoms has followed the removal of impacted teeth. The most convincing treatise I have found on this subject is a little book entitled "Insomnia and Nerve Strain," by Henry S. Upson, M.D., professor of diseases of the nervous system in Western Reserve University and attending neurologist to Lakeside Hospital, Cleveland, Ohio. He has been frequently quoted in dental literature by Dr. Edward C. Kirk and others. Dr. Upson stresses the point that mental and nervous disorders are too often looked on as hopeless and not enough effort is expended in the direction of attempting to cure them. "So long as a psychosis is to the physician a disease without a lesion, sufferers from that dread malady of the soul will be given care with practically no treatment, pity with practically no hope." If Dr. Upson's contention is true, is it not our duty to look for impactions in all those patients coming under our care who give evidence of any mental or nervous lack of balance, and should we not advise the removal of such impacted teeth even though we cannot *prove* that they are responsible for the psychoses? I fear that the stand Dr. Moorehead has taken may be productive of harm. If, as he says, we know practically nothing about these mental disorders, it is all the more important that we utilize what bits of knowledge we have. I do not believe in the indiscriminate removal of teeth, but I think we can afford to experiment a little with these cases as we have so much to gain and so little to lose. If there is any possible way, by elimination or otherwise, of locating a lesion to account for these disorders, it is our duty to do it. We meet a great many people who are physically normal in most respects but lack nervous balance. This may show itself in nothing more pronounced than a slight irritability as cited by Dr. Aison in some of his cases. It has been my observation that the majority of adults having impacted teeth show this lack of balance, and I think we should remove the cause before the condition becomes fixed or develops into something more serious.

Dr. Aison (closing): Dr. Moorehead said he did not know much about psychiatry, neither does anybody else. It is true that clinical psychiatry is still to a large extent an empiric practice. However, we know that recent investigations in this field and modern methods of practice resulted in a great step forward in clarifying and eliminating many hitherto unknown causes of certain mental and nervous manifestations. Coincidence is possible, of course, but not always. When patients who are pronounced insane or who suffer from one type or another of mental aberration recover their normal mental faculties after their diseased and impacted teeth are removed, I believe it very significant. I also believe that it is important for physicians, dentists and specialists to take cognizance of these conditions in their search for possible etiologic factors. The need of more serious attention to the dental and oral abnormalities of those suffering from nervous diseases, especially of the functional type, cannot be overemphasized, for it is a phase frequently overlooked. I attempted here to present the facts as impartially and completely as possible. Evaluate them conservatively. Extraction is not a panacea for all ills. I do not believe that the last word has as yet been said on this subject. In the present lack of exact knowledge of the functions and processes of living matter, we are frequently confronted with problems in connection with mental, nervous and other phenomena which at the present time remain unsolved. It is hoped, therefore, that further study and investigation will be encouraged and that more light will be thrown on those obscure conditions for which there is not at all times sufficient explanation.

THE CAPILLARIES OF THE ENAMEL AND THEIR RELATION TO MOTTLED TEETH*

By THEODORE B. BEUST,† Louisville, Kentucky

THE word capillary, in the sense used in this contribution, means a fine canal, tube or vessel. The supposition that human enamel contains capillaries has heretofore been generally rejected. It is my intention to present evidence of such a nature that a capillarity of this tissue can no longer be a matter of doubt.

Some of you may possibly remember that I began work on the enamel capillaries in 1911.[1] D. Caush, in 1904,[2] through his staining methods and research, proved that the assumption of von Ebner, in 1880, that enamel contained tubes was correct. No attention was given contributions to this subject in our country and American textbook writers failed to consider the capillarity, for the simple reason that J. Leon Williams, recognized authority on enamel, rejected the views held concerning their presence. In a recent "re-investigation," he has accepted this view, and his latest work[3] presents good pictures of the various tubular elements that had previously been described, whereby the investigations of various observers, carried out between 1900 and the date of publication of his article, were duplicated. Williams, in this reinvestigation, adds nothing to what was disclosed in my publication of 1912.[1] His array of illustrations, however, will popularize the subject.

Obviously, the mere demonstration of capillaries in the enamel, then, will only permit of profound conclusions, if it can likewise be shown that these capillaries are continuous with the circulatory sinuses of the organism. Proof of such continuity would automatically ascribe to them biologic functions. Pickerill[4] questioned the validity of my experiments which established such proof in 1914, but as Mummery (1922),[5] and, later Bodecker (1923)[6]

*This paper is discussed jointly with Dr. Pierle on page 1009.

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Sixty-Seventh Annual Session of the American Dental Association, Louisville, Ky., Sept. 23, 1925.

†Working under grant from the Research Commission of the American Dental Association.

1. Beust, T. B.: Dent. Cosmos, 54: 659 (June) 1912.

2. Caush, D.: Tr. Fourth Internat. Cong., Vol. 1.

3. Williams, J. L.: J. Dent. Res., 5 (April) 1925.

4. Pickerill, H. P.: Dent. Cosmos, 55: 969 (Oct.) 1913.

5. Mummery, J. H.: Brit. Dent. J., 43: 607 (July) 1922.

6. Bodecker, C. F.: Permeability of Enamel in Relation to Stains, J.A.D.A., 10: 60 (Jan.) 1923.

and Malleson (1924),[7] have since then confirmed my technic, we may consider this part of my first investigation verified.

In a paper read before the Cleveland Session of the American Dental Association,[8] I made an attempt to show the distribution of the capillary content of the enamel. I displayed two views[9] of a plaster model, which showed their occurrence in parallel segmented rows.

Fig. 1.—Camera lucida drawing of the undersurface of the enamel on a plaster model.

A camera lucida drawing of the enamel undersurface in that contribution showed the row segments in cross-section and displayed variously curved lines marking the points of origin. In 1924,[10] I attempted to demonstrate the result when such bundles or sheets of tubes were sectioned, and I contended that the striae of Retzius were produced in that way. The figure (No. 4) from that contribution, which showed a ring of enamel represented as a transparent object, gives some idea of the tubular distribution. These vessels I regarded as the avenues through which metabolic fluids must course from the pulp to the enamel periphery.

Fig. 2.—Wire model of a "spiral."

Recent investigations now permit a more detailed description of these parallel rows of capillaries than was at that time possible, and, in addition, render intelligible some of the hitherto obscure phenomena observable in enamel sections.

A description of these systems may well begin with the conditions presented at the amelodentinal junction. Figure 1 shows some of the markings found on the undersurface of the labial enamel shell of a central incisor. The lines shown represent the "hila."[11] As these

7. Malleson: Dental Histology and Bacteriology, 1924.

8. Beust, T. B.: Physiologic Changes in the Structure of the Enamel After Tooth Eruption, J.A.D.A., 11: 396 (May) 1924.

9. Footnote 8, page 398.

10. Beust, T. B.: Dent. Cosmos, 55: 614 (June) 1924.

11. Beust, T. B.: Dent. Summary, 44: 474 (June) 1924.

crevise-like figures admit the vessels, the term hilum appeared appropriate. Two drawings were published in this contribution. One shows the under surface of the enamel of a third molar. The other shows that each hilum marks the points of entrance of tubes arranged in a row. These radiate as spiral ribbon-shaped units (Fig. 2) toward the outer enamel surface, dividing the inner regions of the enamel into relatively perpendicular plates. The ultimate peripheral distribution of the individual tubal elements of such a ribbon has

Fig. 3.—Spirals seen from the enamel surface: *a*, inner or vertical rows; *b*, outer or horizontal rows.

heretofore baffled all attempts at description. It is to the relations of these tubes in the outer regions of the enamel that the following remarks apply.

In their course toward the enamel surface, these spiraliform figures undergo a peculiar twisting. This turn in the figure is apparently characteristic of the enamel of all teeth. At a point about midway between the amelodentinal junction and the enamel surface, the elements (tubes) composing the ribbon, which up to here display considerable magnitude, undergo diminution in caliber. The figure resulting from this rotation is, at the amelodentinal junction, disposed longitudinally and, at the periphery or enamel surface, it is disposed at right angles to the long axis of the tooth (Fig. 3). As the spiral figures emanating from the hila of adjoining rows thus meet in the outer enamel tissue, we have a series of parallel rows formed which run at right angles to the rows of the inner enamel region. Frequently, these rows are found to be confluent. The external

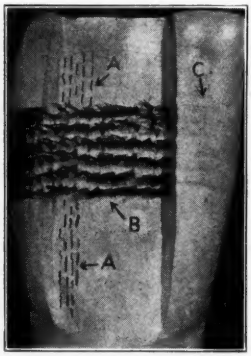

Fig. 4.—Stereoradiogram of an incisor: *a*, lines (hila) showing the points of origin of the spiraliform figures; *b*, horizontal rows formed by the twisting of the figures; *c*, imbrication lines.

outlet of each series of tubes appears to lie in the valleys between the imbrication lines of Pickerill[11] (Fig. 4). The described turn in the figures explains the enamel "whorls," it being assumed that the tubes follow the rods. These findings are based upon the observation of a large number of sections and are supported by facts about to be presented.

PHOTOMICROGRAPHIC EVIDENCE

Although diagrams usually portray interpretations better than photographs,

it is usually very difficult for those not directly engaged with the subject being studied to become oriented. I have, therefore, prepared a number of photomicrographs which will render intelligible the methods employed and verify the conclusions. In this research, thick cross-sections of enamel, sections varying between one-fourth of and the entire enamel covering of the tooth were used. Such relatively opaque objects are photographed only with difficulty. Objectives of low power, with long working distance, must be used. Through their use, it is possible to follow the tubes in their path through the enamel and catalog the observations by means of the photographic plate.

Fig. 5.—Photomicrograph of the under surface of labial enamel (transmitted light).

The first photograph (Fig. 5), taken by light transmitted through the entire labial plate of a central incisor, shows some of the hila which were drawn on the plaster model, Figure 1. The next illustration, Figure 6, is a reflected-light photograph of the same specimen.

The enamel above shown consisted of fragments chipped from dried teeth. The photographs which follow were made from enamel which was never allowed to dry out and which was subjected to graded concentrations only.

We will now consider a series of photographs of an enamel cross-section.

Fig. 6.—Specimen shown in Figure 5, by reflected light.

This specimen is mounted between two cover-glasses. Figure 7 shows the longitudinal parallel rows as they are seen under the low power of 42 mm. Figure 8 gives us a view under the 16 mm. lens. Without moving the preparation, all that lies between the surface here shown and the lower or dentin surface may be studied by simply approximating the lens to the preparation. This was the plan followed in this study. The capillaries were traced in section after

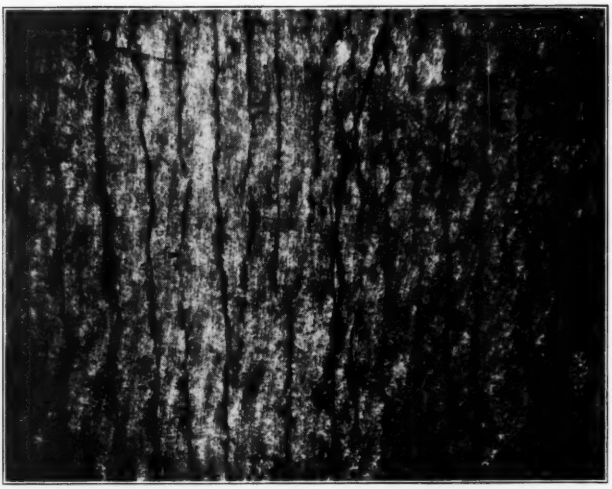

Fig. 7.—View (42 mm.) of parallel rows.

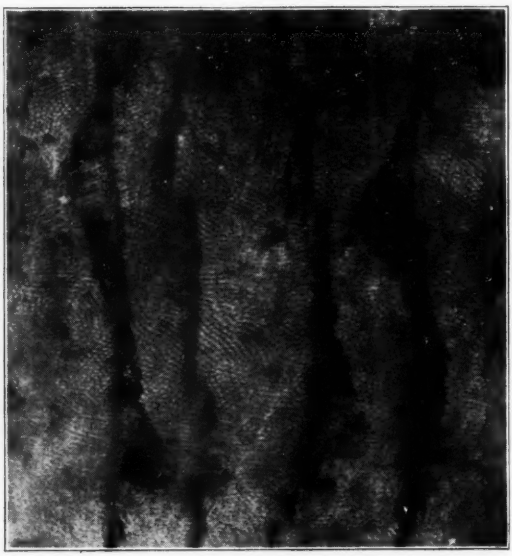

Fig. 8.—View (16 mm.) of parallel rows.

section until their definite arrangement was determined beyond question. That

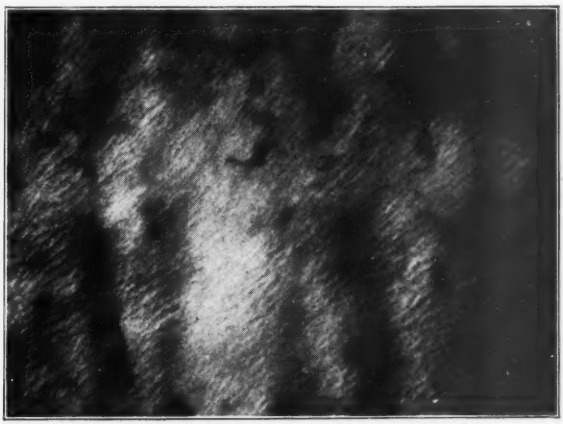

Fig. 9.—Dentin of the specimen shown in Figure 8, photographed from the enamel side, through the enamel.

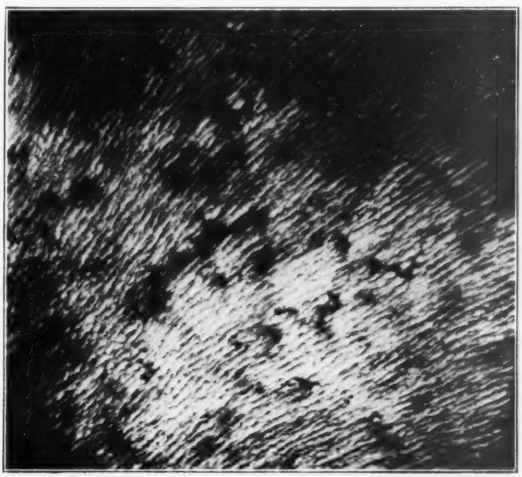

Fig. 10.—The under surface of the foregoing specimen.

one can see and study the space intervening between this surface and that which lies far below can be realized from the picture resulting from the lowering of the focal plane. (Fig. 9.) This view was made by photographing

through the surface shown in the former picture. The view extends down into the dentin, even to the interglobular spaces. The section is now reversed and the former under or dentin surface photographed. Figure 10 shows the nature of the tissue on that side. The contained capillaries can be traced from one of the surfaces of the section to the other, and that the parallel rows of hila are not an artefact or that they represent so many cracks. A critical inspection of the dentin surface proves that the specimen is intact.

Fig. 11.—The enamel of the specimen shown in Figure 10, photographed from the dentin side, through the dentin.

focal plane is now transferred, without moving the preparation, to the opposite or enamel side, and an exposure is made through the layer of dentin exhibited. The result is that the hila shown in the initial photograph become visible (Fig. 11). This series of photographs shows that one can photograph through thick sections of enamel; that

In some of these photographs the parallel rows of hila appear continuous. This is not always the case. In Figure 12, long and short hila may be seen. Those appearing continuous are not always so, as the interruption in the segment, owing to the angle at which the tubes leave the dentin, often comes to lie in a shadow.

In an earlier contribution,[11] I contended that the hila were composed of

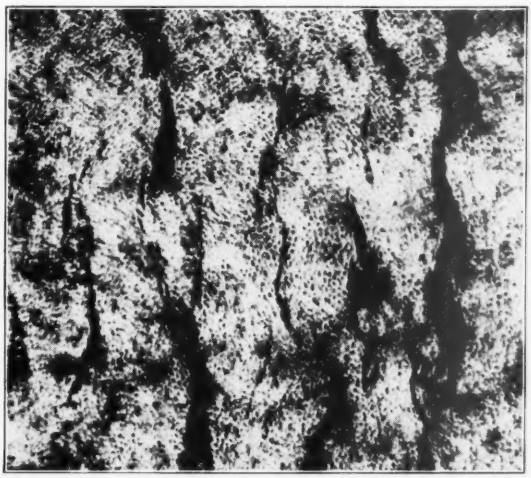

Fig. 12.—Long and short "hila."

rows of individual tubes. Figure 13 which was taken with the 4 mm. lens, is an example of the tube rows, the elements, the tubes, being clearly seen. Near their points of origin, they communicate with one another by means of membranous or thornlike processes.

In my 1912 contribution,[1] photographs of these, the main avenues of capillary flow into the enamel, were shown. The finer avenues were in this article described as "half-moon shaped lines partially enveloping the rods." Recently J. Leon Williams dwells on this point. He seems to have overlooked my discovery of these canals. Two photographs in his recent work show them beautifully.

THE SPIRALIFORM FIGURES

Although the spiraliform figures are seen in every specimen of enamel, no attempt has been made as yet, to my knowledge, to determine their distribution. The problem at first seemed beset with insurmountable difficulties, and it was only by evolving a scheme of graded sectioning that the relations

Fig. 13.—Tubes entering a hilum.

could be definitely ascertained. As I propose to show, they exhibit as much

consistency in distribution as the fibers of a muscle. To comprehend their

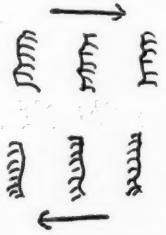

Fig. 14.—Alternation in direction of the tubes.

form, the figure of the spiral already shown, which was represented as emanating at right angles from the long axis of the tooth, must be borne in mind. The capillaries, as may be seen, leave the hila in alternate rotation. (Fig. 14.) One sheet of tubes is

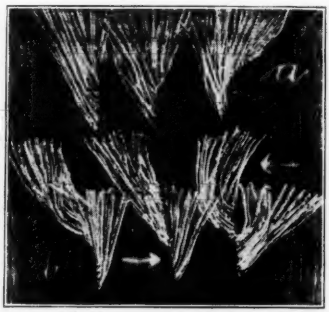

Fig. 15.—Model showing distribution of the spirals.

directed to the right, the next row to the left. In common with the rods, they leave the dentin in most parts of

Fig. 16—Right and left turns of the tubes.

the tooth at an acute angle, as is seen in Figure 15. By examining this model carefully, it will be seen that the lower half of the lower row of spirals turn to the right, while the upper half of the lower row rotates to the left. The top row (*a*) of spirals on this model is twisted on itself. Both forms are found.

We will now see how the photomicrographs agree with these interpretations. Figure 16 represents an enamel cross-section. The surface here shown belongs to the inner regions, the tubes being sectioned near their points of origin. It will be seen that the capillaries here shown emanate as an almost continuous ribbon. Those leaving the hila above the line are deflected toward the left, while those below are deflected toward the right, as the arrows indicate. A similar phenomenon is shown in Figure 17. The upper or outer third of the spirals, I should judge, has here been removed in grinding. The alternate rotation of the figures is here also evident. The next photograph (Fig. 18) is marked for better orientation. On sections of this kind, the tubes can be traced from the surface down to their points of origin at the amelodentinal junction. For example, there is dentin underlying the spirals on this preparation. By lowering the ob-

Fig. 17.—Alternation in the distribution of the capillaries.

jective, it is easily seen. Figure 19 shows this to be the case. It was photographed through the spiraliform figures and is therefore rather blurred. Figure 20 is taken from the dentin side of this preparation, the hila showing through a layer of dentin.

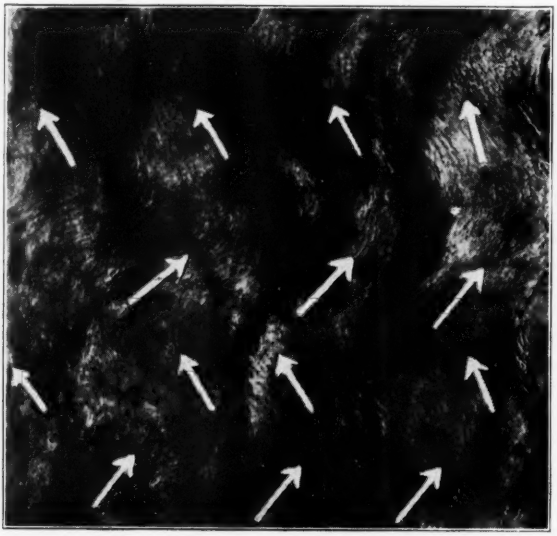

Fig. 18.—Arrows indicating alternation in capillary distribution.

Fig. 19.—Dentin underlying the enamel shown in Figure 8 (photographed through the enamel).

It will now seem probable that the enamel is vascular to an extreme degree. The next photomicrograph

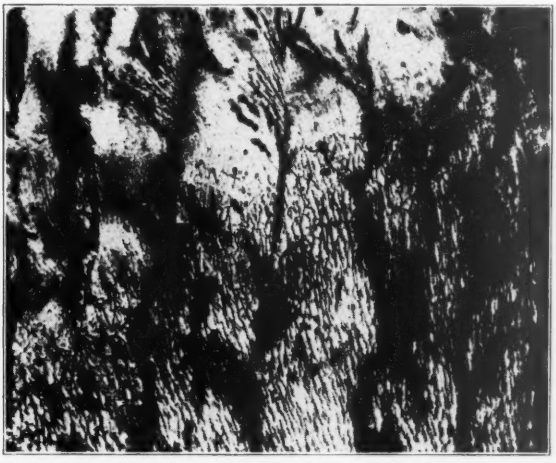

Fig. 20.—The dentin shown in Figure 19 photographed from the dentin side.

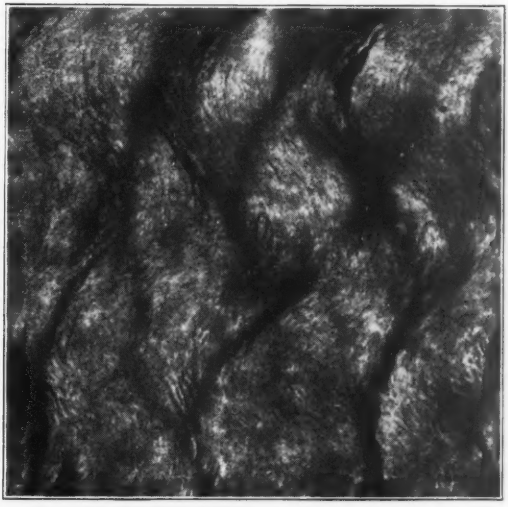

Fig. 21.—Capillary distribution (16 mm. view).

(Fig. 21), taken with the 16 mm. lens, is another exposition of the wealth of

Fig. 22.—Naturally mottled teeth, stained with fuchsin.

capillaries present. The vessels that permeate the enamel in countless sheets will admit colloidal fluids and, therefore, lymph. Any chemicophysicist will understand what this fact implies. J. Leon Williams is in error in calling these sinuses defects. As they are an

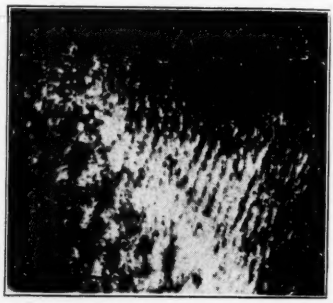

Fig. 24.—Portion of the cingulum (16 mm. view).

integral part of enamel, without them there would be no enamel.

THE CAPILLARIES IN THEIR RELATION TO MOTTLED ENAMEL

In a paper read before the Research Section of the American Dental Asso-

Fig. 23.—The cingulum of the specimen shown in Figure 22.

ciation at Dallas,[11] my conception of a chemicotraumatic origin of mottled enamel was supported by the following histologic observations:

1. The agency causing the lesion enters the enamel from without centripetally, traverses these capillaries, etches their walls and apparently dilates them.

2. The agency attacks the rod from the lumen of the capillary, gradually breaking it down.

3. The lesion can be duplicated experimentally by exposing teeth to various solutions.

4. The agency follows the enamel capillaries, reaches and follows the dentinal tubules and attacks the interfibrillar dentin or matrix, producing mottling of the dentin.

These facts are opposed to the developmental hypothesis entertained by Black, Williams and others.

We will now consider some photomicrographic evidence verifying my paper read at Dallas.

Figure 22 shows a stained section of a mottled incisor. Figure 23 shows its cingulum. Figure 24 is a higher power photomicrograph of the cingulum just shown and gives a view of a portion in which the healthy tissue mingles with the mottled tissue, the agency having entered between the rods, through the capillaries.

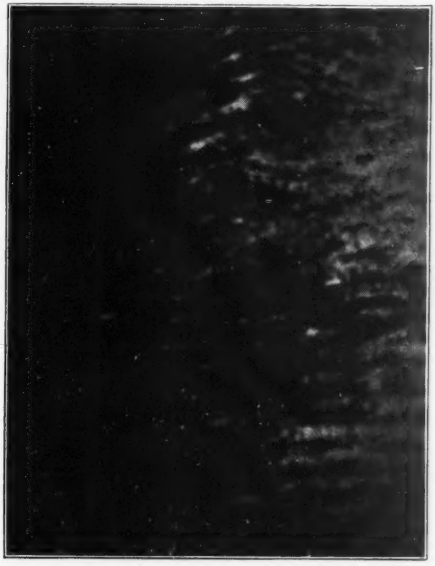

Fig. 25.—An amplification of the specimen shown in Figure 24.

Figure 25 shows an amplification of a part of the foregoing. Figure 26 shows where the agency has penetrated the morphologically intact enamel and entered the dentin tubules and is attacking the interfibrillar dentin matrix.

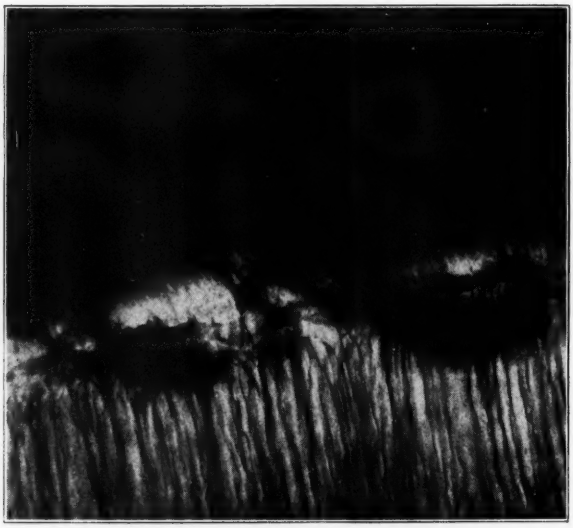

Fig. 26.—A naturally mottled specimen, stained with fuchsin, showing affected dentin.

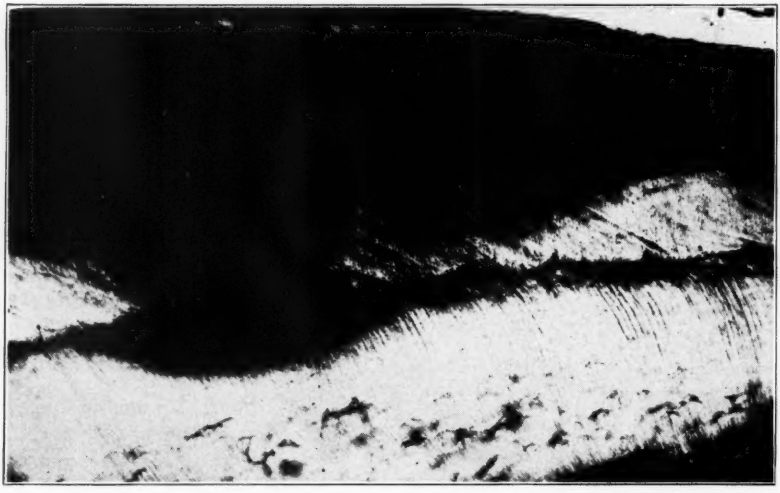

Fig. 27.—An artificially mottled specimen showing a duplication of phenomena exhibited by the foregoing.

Figure 27 shows artificially mottled enamel. The agency has penetrated the morphologically intact enamel and the dentin. By morphologically intact enamel, I mean enamel that still retains its form and contours. The rods, of course, are partially decomposed.

Figures 28 and 29 show the familiar stratifications seen in longitudinal sections of enamel. In the sections here shown, the striae of Retzius are stained red. The healthy rod substance failed to take the stain. As these teeth were stained in bulk and afterward sectioned, it must be assumed that the stain penetrated the tubes and that the striae are

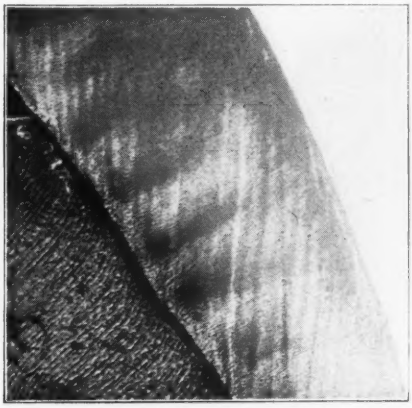

Fig. 28.—Characteristic markings of the enamel stained red with fuchsin.

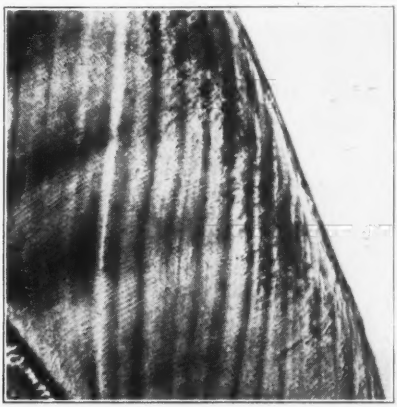

Fig. 29.—A specimen showing duplication of the same phenomena.

the sectioned capillary sheets. A like interpretation was advanced by Caush in 1904.

Fig. 30.—Plaster model carved after a camera lucida drawing by Dr. A. E. Lang.

EXPERIMENTS WITH ETCHING FLUIDS

In further support of the theories here presented concerning the microstructure of the enamel, I shall outline the results of experiments at etching enamel with acids of modified concentration. It will be evident that these harmonize with the interpretation regarding the tube distribution.

If enamel is alternately etched with 5 per cent lactic acid and brushed with a soft brush, a peculiar phenomenon is observable. The acid entering the tube sheets attacks the tissue in their immediate vicinity first, a peculiar ridging resulting, which corresponds to the above outlined distribution of the sheets. First, we shall study a plaster model (Fig. 30) carved by an assistant after the camera lucida drawing.

It will be observed that the model is covered with a series of furrows. Those forming in the outer regions of the enamel, where the removal of tissue by the acid has not progressed so far are

Fig. 31.—Photomicrograph of the original specimen treated (reflected light).

disposed at right angles to the long axis of the tooth and may be termed horizontal furrows. As calcification proceeds to the deeper regions, we find that the furrows are more deeply scalloped, the scalloping corresponding to the described twist in the spirals. The obliquity increases as the tissue is farther removed until, in the inner one-fourth, relatively speaking, of the enamel, the furrows become perpendicular or longitudinal. *A* represents the inner regions, nearest the amelodentinal boundary. *A*1 shows the region of scalloped furrows. *B* illustrates the tissue in the outer third and *C shows* intact enamel, which was protected by wax during the experiment. *D* represents the dentin, which also displays perpendicular ridging (longitudinal with the long axis of the tooth). These markings exhibited by the dentin will be made the objects of special study.

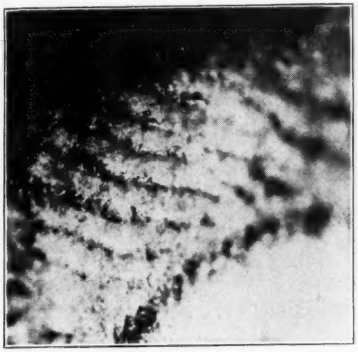

Fig. 32.—Appearance near the gingival margin.

Fig. 33.—Appearance at the lingual fissure.

Fig. 34.—Appearance of the deeper enamel regions (rows now perpendicular).

We will now see how the photo-

micrographs of the tooth after which this model was carved agree with this representation.

Figure 31 gives a view of the lingual surface of the lower second molar, which was the tooth used in the experiment. It shows the occlusal third and corresponds to our model. Figure 32 is a photomicrograph of the tissue nearer the gingival margin. In its lower parts, the perpendicular rows (out of focus) are faintly visible. Figure 33 shows the region of the lingual fissure. Figure 34 was made with the lens focused on the scalloped furrows, both the scalloped and perpendicular rows being in evidence. Figure 35 shows the innermost part of the enamel, the region of the parallel rows emanating from the hila.

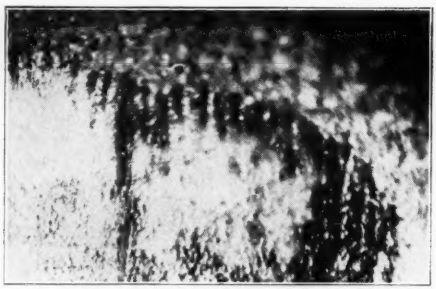

Fig. 35.—Innermost enamel region (perpendicular rows).

CONCLUSION

The new and important points that have been revealed in this research may be briefly expressed as follows:

1. The prevalence of the capillaries has been determined.

2. Their exact mode of distribution has been shown.

3. The arrangement of the enamel rods in human enamel has been ascertained, for it must be assumed that the canals follow the rods.

4. The histologic studies have contributed farther evidence in support of the view that the agency producing mottled enamel must enter the capillaries from without.

PRODUCTION OF MOTTLING AND OF BROWN STAIN*

By C. A. PIERLE, Ph.D., Canyon, Texas

ACCORDING to the investigations of Dr. G. V. Black[1] and Dr. McKay,[2] the prevalence of "brown stain" in certain areas of southern Colorado and Northwestern Texas is due to the water supply, and the conclusion was reached that there is in the water some trace of rare elements that have escaped notice in the ordinary chemical analysis of the water. The general facts in regard to its prevalence, its peculiarities of occurrence and its general characteristics have all been checked and verified. No conclusions were reached as to its cause, nor are any suggestions offered for preventing or helping the situation.

Work was begun in the spring of 1923 in checking up the observations of others and looking for some cause for the occurrence of this disfiguring affectation of the teeth. In this work, the public schools offered every facility for studying at first-hand the conditions as they now exist, and the fact that the student body of West Texas State Teachers College, located at Canyon, comes from a radius of 100 miles around Canyon suggested a means of finding the probable extent of the endemic area. The problem was first approached through a questionnaire given the students, from which information concerning place of birth and subsequent changes of location, age when making the change, and as to whether they or their immediate families were victims of brown stain was obtained. There was a general agreement among all reports turned in which indicated that if a child was born and reared within the area, its chances of escaping the condition were small. In all cases where the residence data showed a possibility of affectation and none was reported, or it was reported as present and the residence record would appear doubtful, a personal examination was made of such cases as were accessible. The facts brought out by this method are believed to be as reliable as could possibly be secured without a personal examination and record of each person living within the area. These findings in brief are:

1. If a child is born within the endemic area and grows to maturity within the area, he will probably have mottled or brown teeth.

2. If he is born outside the area and

*Work done at the West Texas State Teachers' College under a grant from the Research Commission of the American Dental Association.

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Sixty-Seventh Annual Session of the American Dental Association, Louisville, Ky., Sept. 23, 1925.

1. Black, G. V.: Dent. Cosmos, 58: 142 (Feb.) 1916.

2. McKay, F. S.: Dent. Cosmos, 58: 628 (June) 1916.

moves to the endemic section any time before the eruption of the permanent teeth, his chances of escape are small.

3. Those who have moved into this territory after 14 or 16 years of age are rarely marked, and if at all, the only markings will be on third molars.

4. The condition is in no way connected with mouth hygiene, as it attacks rich and poor, clean and unclean in like manner.

5. The condition of the teeth in the various individuals differs widely. Sometimes, the teeth are mottled with paper white spots; sometimes they are striated; again they are pitted with shallow holes or show ridges on the labial surface. Many are brown over the entire labial surface, while others are streaked transversely with brown. There are numerous cases in which the teeth are white mottled with brown, though I have not yet seen a brown tooth that did not show mottling in part.

6. The brown appears in nearly all cases on the upper central and lateral incisors and most prominently on the labial surface.

7. The mottled and brown teeth are irregular in appearance, in shape and in size.

8. The mottling of the teeth and the brown stain are a part of one and the same problem.

9. The deciduous teeth rarely show brown, though occasionally these are mottled.

10. The permanent teeth erupt mottled, and then gradually take on the brown stain.

Although this condition has been known to exist for years, it is only recently that it has been considered a problem of other than local interest. The area in Texas alone, mapped from data collected from the student body of the West Texas State Teachers' College, includes eighty-six of the 252 counties of Texas. These counties cover an area of 69,197 square miles, and had, in 1920, a population of 450,441. The school population of this area, children between 7 and 18 years, was, in 1923-1924, 147,707. Forty-four per cent of the 1,200 cases examined showed either white mottled or brown stain; while data from others not seen gives an average of 45 per cent. In the latter, account has been taken only, of those having brown stain. Few data were obtained from adjoining regions but it is well known that the same general conditions exist in Western Oklahoma, Southern Colorado and Eastern New Mexico; while there are areas of smaller extent in parts of Texas not included in the part above mentioned. There is no possibility of longer considering this as a purely local problem.

Two avenues of approach naturally suggest themselves for this problem: (1) the water used and (2) the food supply of the country, or, as is more probable, a combination of the two. An inquiry into the diet on which nearly all of the children having brown teeth have been reared shows that they have subsisted, during the growing period, largely on food deficient in calcium. Meat has contributed the protein and fats; white bread, potatoes and dried beans, the carbohydrates. Occasionally, they have had a bit of fruit, and a few green vegetables during the short growing season. Only within the last few years have milk and milk products come into their own. Green vegetables and milk are not so widely used today as they should be, owing, no doubt, to the difficulty of growing them and to the cost of importing them from other places. The information concerning the

diet has been obtained partly from observation, and partly from lists of menus furnished by teachers boarding with families in rural districts.

Taking the average of minimum needs as 0.45 gm. of calcium per man each day,[3] and calculating the amount of food necessary to supply this minimum from such foods as are listed, we find that a man weighing 150 pounds would need to consume of lean beef alone, 14 pounds; of white flour, 5 pounds; of dried beans, 0.6 pound; of potatoes, 7.3 pounds; while on a mixed diet of these foods, it is doubtful that the minimum amount would be obtained. Considering that the growing child is storing calcium at an average of from 0.2 to 0.4 gm. a day, it would seem that the amount of calcium necessary for normal growth in children should be somewhat greater than that needed for an adult. The only possible source of calcium, other than the food, is the water, and it would require the consumption of a large amount of ordinary drinking water or an exceptionally hard water to supply the calcium requirements. Dependence on the water used in Canyon, Texas, would require a daily consumption of 8 gallons to meet the minimum requirement of an adult. On the other hand, a pint of milk daily would more than meet the minimum requirement.

EXPERIMENTAL DATA

Working from the hypothesis that the cause of mottled teeth was the low calcium intake from the food and water used, feeding experiments were started with white rats and guinea-pigs, in order to determine whether anything resembling mottled teeth or brown stain could be produced. Water from wells where the children were known to have affected teeth was used, as was also water from wells where the family had good teeth. The diet used was selected to conform as nearly as possible with average diets furnished or procured by observation. The deficient diet chosen for the rats consisted of meat, whole maize, wheat bran and butter fat, with green vegetables fed twice a week. The diet for the control animals was the same as that used in the deficiency experiments except that it included whole milk, *ad libitum*, and green vegetables daily.

The guinea-pigs received bran and whole maize with green leaves daily because of the susceptibility to water soluble vitamin C. Because of this addition to the diet, it has been impossible to carry the pigs on as low a mineral content as I wished to. The control animals received milk in addition to the foregoing diet. These experiments have all been qualitative in character. No attempt has been made to limit the amount eaten, but food has been kept before the animals at all times.

Experiment 1—A pair of young rats were placed on the calcium deficient diet, Nov. 22, 1924. The water given them was taken from a well 80 feet deep. The younger members of the family reared on the water all had mottled and brown teeth. The oldest child, a youth, aged 20, began using this water at the age of 6. The only mark that showed on his teeth was a slight, white mottling on the third molars, which had recently erupted. The children stated that they had never been very heavy users of milk, though they could have had all that they wanted.

3. Sherman, H. C.: Chemistry of Food and Nutrition, New York: The Macmillan Company, 1915.

The composition of this water is given in Table 1.

Fig. 1.—Head of rat from Litter 1. The teeth were pulled out of alinement by muscular pull on a weakened bone structure. Opposite upper and lower incisors are articulated in part, the others failing to articulate. The skull was extremely thin and decalcified.

TABLE 1.—COMPOSITION OF WATER IN EXPERIMENT 1.

	Parts per Million
Silicon dioxid	23.30
Chlorin	126.45
Calcium oxid	243.30
Magnesium oxid	32.70
Iron and aluminum oxids	25.50
Sulphur trioxid	146.40
Total hardness	174.70
Permanent hardness	90.00
Temporary hardness	84.70
Total solids	1,041.00
Potassium oxid and sodium oxid	Undetermined

This pair of rats produced a litter of ten young, January 5. The young made fair growth and only recently have the males from this litter shown any signs of mottling. One of the males (Fig. 1) early showed teeth that were being pulled out of alinement to such a degree that the animal ate with difficulty. The upper incisors were slightly mottled. The three females were bred in March. Two produced litters, but died during lactation. The third died during gestation. It became necessary to bring up the two litters on cow's milk, and they have not as yet shown any signs of mottled teeth. An examination of the skull of the rat (Fig. 2) that died during gestation shows a decalcified bony structure, but the teeth were only slightly mottled at the time of death.

The original female, bred a second time in March, produced a second litter in April. This litter did not develop so fast as the first and began to show

Fig. 2.—Head of female rat from Litter 1, Experiment 1. This rat died during her first gestation period. Owing to a low calcium intake, she was unable to sustain life long enough to produce young. The head shows extreme decalcification.

mottled teeth earlier than did the first litter. This mottling took the form of white lines, in spots visible along the sides of the upper incisors. The original female produced the third litter in July, and, on showing signs of weakening during lactation, she was taken from the young and restored to normal by supplementing her diet with milk.

Experiment 2—Rat 2 was given a diet in all particulars similar to that of Rat 1. The water used was from a well which furnished the water for a family of seven children, none of whose teeth showed mottling or brown stain. This water was never completely analyzed. A partial analysis is given in Table 2.

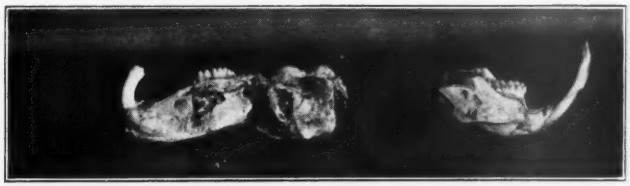

Fig. 3.—Skull of a rat from Litter 1, Experiment 2. The teeth were badly mottled and irregular and did not articulate. The skull bones were almost entirely decalcified. The upper molars on the right side were missing.

TABLE 2.—PARTIAL ANALYSIS OF WATER IN EXPERIMENT 2.

	Parts per Million
Total solids	246.10
Silicon dioxid	36.57
Calcium oxid	14.60
Magnesium oxid	22.66
Chlorin	12.50
Aluminum and iron oxids	——
Potassium and sodium oxids	——
Sulphate as SO_3	——
Permanent hardness	134.40
Temporary hardness	16.30

The first litter of rats produced on this water were under size at birth and never did grow and develop normally. The teeth showed mottling at an early age and almost from the first showed signs of calcium deficiency. Figure 3 shows the condition found in one of the rats from the litter, which was killed when it became too weak to care for itself. All of the extreme cases of rickets were obtained from this litter, and, with one exception, all of the irregular specimens which we have. This is not surprising when we consider the wide difference in the calcium content of this water as compared with the water in Experiment 1. Figure 4 shows a contrast of the skeletons of one rat from this litter with that with one taken from the control experiment. The rat from Litter 1, Experiment 2, was killed when 4 months old. The skeleton used for contrast was that of one of the protected rats, which was killed at the age of 3 months.

The only explanation for the absence of marks on the teeth of the children using this water must lie in the food used. Inquiry substantiates this, as the mother states that she has always used eggs, and green vegetables when procurable, and has always insisted on all the children drinking milk thrice daily. It is quite evident in this case that the calcium deficiency in the water has been made up in the food used.

The calcium deficiency in the diet in this experiment has manifested itself at an earlier period in the second litter than in the first. It would have been impossible for this rat to have suckled her second litter of young until they were old enough to be weaned had she not been given milk once a day during the last two weeks the young were nursing. All of the young from the second litter showed results of calcium deficiency, and all had decidedly mottled teeth and poor bone development.

TABLE 3.—ANALYSIS OF WATER IN EXPERIMENT 3.

	Parts per Million
Total solids	1,334.0
Silicon dioxid	95.5
Iron oxid (FE_2O_3)	14.0
Aluminum oxid (AL_2O_3)	8.0
Magnesium oxid	32.2
Calcium oxid	127.3
Sulphur trioxid (SO_3)	71.0
Chlorin	162.0
Permanent hardness	312.0
Temporary hardness	22.7
Sodium and potassium oxid	516.0

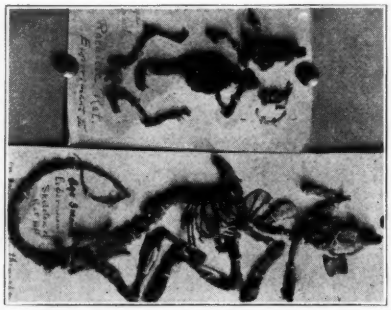

Fig. 4.—The skeletal structure of a rachitic rat from Experiment 2, as compared with one from Experiment 4. That from Experiment 2 was kept for four months on a calcium deficient diet, while that from Experiment 4 was on a protective diet and was 3 months old when killed.

Experiment 3—Experiment No. 3 closely parallels Experiment No. 1. The food was identical, the only difference being in the water used.

Water for this experiment was obtained from a well 120 feet deep. The analysis is given in Table 3.

The first litter of young from this experiment developed fairly well and were slow in showing mottled teeth. The second litter made a slower growth and began to show mottled teeth at an earlier age. The mother died during the lactation period of the third litter, when the young were 3½ weeks old, and it was necessary to supplement their food with milk in order to save them. The addition of milk to their ration caused a more rapid growth in the third litter and, up to date, this litter has shown no mottling, though they have now been two months and a half without milk. Examination of the teeth and skull of the mother rat (Fig. 5) showed slightly mottled teeth, but her skull and jaw bones were almost entirely decalcified.

The tendency to mottled teeth and poorer bone structure noted in the successive litters in these experiments closely parallels observations made in large families of children. The older

children were found to have better teeth and apparently better bone structure than the younger ones. Especially is this noticeable where the children have been born in rapid succession. It is quite evident that the drain on the calcium intake of the mother has left an insufficient supply to meet the needs and requirement of the second fetus during gestation or to supply the calcium requirement for the nursing child.

Experiment 4—This was in the nature of a control experiment with a view to the prevention of mottled teeth. This rat was started on the same diet trouble. There can be no doubt that the milk added to the diet has supplied

TABLE 4.—ANALYSIS OF WATER IN EXPERIMENT 4.

	Parts per Million
Total solids	407.57
Silicon dioxid	12.38
Aluminum and iron oxid	25.80
Calcium oxid	18.76
Magnesium oxid	13.28
Sulphur trioxid	35.80
Chlorin	38.50
Potassium and sodium oxid	——
Permanent hardness	48.80
Temporary hardness	5.50

Fig. 5.—Head of the original female rat of Experiment 3, which died during the third lactation period. The teeth were decidedly mottled and the skull decalcified. This illustrates the effect of continuous bearing of young when there is an insufficient mineral intake.

used in all the other experiments except that whole milk and lettuce leaves were fed daily.

The water used was from the college well, which is 400 feet deep. The analysis of this water is given in Table 4.

Three litters have been produced from the original rat and two from the single female from the first litter. Growth has been normal in all cases, and there has never been noted in any of the young a single case of mottled teeth. There should have been a close agreement between this water and the water used in Experiment 2, if the water alone is responsible for the these rats with the calcium needed and has been the main factor in the preservation of the teeth and also in the fine growth and development that they have made.

Radiograms (Figs. 6-8) show, in general, the effect of low calcium feeding on the entire bony structure of the rats. Figure 6 shows a rat from the protected litter, while Figures 7 and 8 show rats from the first litter in Experiment 2. These films show conclusively that, when a proper diet is maintained, no malformation of the skeleton occurs, while on an improper diet almost any sort of irregularity may occur. The teeth of the normal rat

shown were clear and translucent, while those of the poorly developed rats were irregular, and showed an opaque chalkiness over the entire upper incisors.

EXPERIMENTAL WORK WITH GUINEA-PIGS

Duplicate experiments with guinea-pigs were started at the same time the work with rats began. It was soon found that the pigs could not be limited in the quality of food, owing to their need for water soluble vitamin C. After losing a few of the first animals, with scurvy, it was found necessary to include in their diet some green food daily. This raised the total amount of calcium somewhat, and it has taken a longer time to notice effects than in the rats. The water used was the same and the results have been quite similar to those in the experiments with rats. All the mothers that have been kept on a diet low in calcium have produced young whose teeth are marked with ridges. These teeth are smaller than normal; are soft and chalky; have decided mottles, and, at the present time, show a brown stain exactly like that found in children. The control animals, which have had milk in addition to the diet fed the others, produced young with as nearly perfect teeth as could be desired. No sign of mottling or staining has occurred in the control experiment.

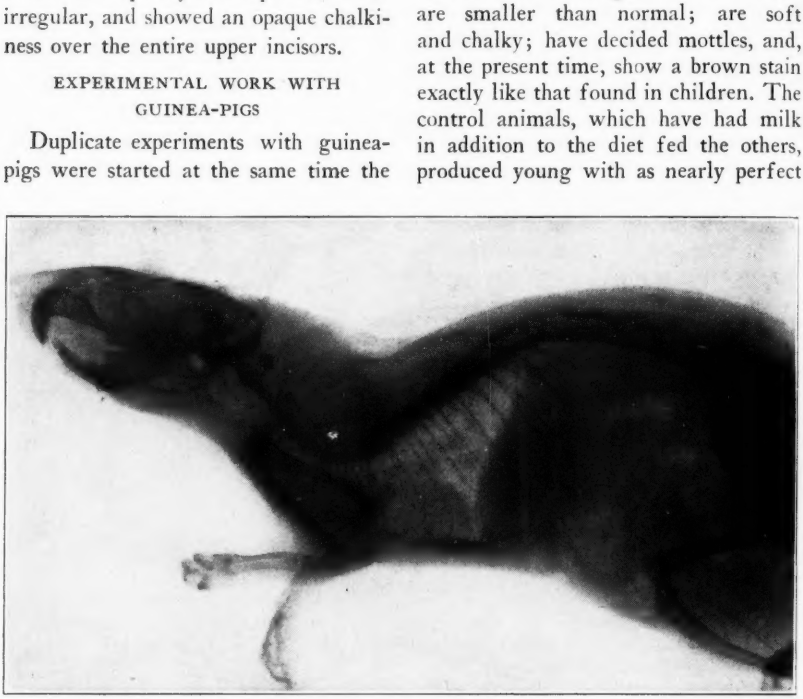

Fig. 6.—Rat kept on a protective diet; showing a regular and well shaped skeleton.

Figure 9 shows one of the control animals whose mother received milk and vegetables daily during gestation, while the pig has had a similar diet all its life. Its teeth have remained perfect throughout the entire experiment.

Figure 10, left, shows what happens to the teeth of guinea-pigs when they are kept on just sufficient green food to prevent scurvy and with no milk added to the diet. The teeth were chalky and brittle, breaking off frequently and

wearing away faster than would be expected. The outer layer of enamel broke off in patches, while in other places, shallow black pits were formed. The general color of the teeth was light brown. On increasing the green food over a period of two months the teeth showed marked improvement, as illustrated in Figure 10, right. The

A question frequently asked is: "Can teeth already brown be cured or improved by increasing the mineral content of the diet in children?" From what has been done with guinea-pigs it would seem possible were it not for the fact that the guinea-pig's tooth is a continually growing thing, while that of the child develops but little after erup-

Fig. 7.—A rat from Experiment 2; showing pronounced rachitic condition as well as irregular teeth.

brown tinge has disappeared and the teeth, though not perfect, are much better than before.

Figure 11, left, shows a pig from the same litter as shown in Figure 10, right. This pig developed the typical brown stain, to all appearances identical with that occurring in children. The picture of the same pig (Fig. 11, right) taken two months later, after an increase in the calcium intake, shows what improvement can be made by increasing the calcium in the diet.

tion. From all indications it should be possible to prevent the occurrence of brown stain by feeding, but it is difficult to remove it after the teeth are formed.

What is the chemical composition of the brown stain? In human teeth, this is a problem yet to be solved. It is exceedingly difficult to approach and, up to date, no way has been found of separating the stain from the surrounding tooth structure. It is useless to rely on grinding because of the inclusion of portions of the abrasive material with

the grinding. Qualitative examination of the entire tooth when dissolved shows no inorganic elements foreign to normal tooth structure.

It has been difficult to secure marked teeth, for their owners are reluctant to part with them. There remains a possible method, which will be to make numerous analyses of stained, mottled and normal teeth and compare the completed analyses. Lack of time is the only excuse offered for data that are insufficient to throw some light on the problem.

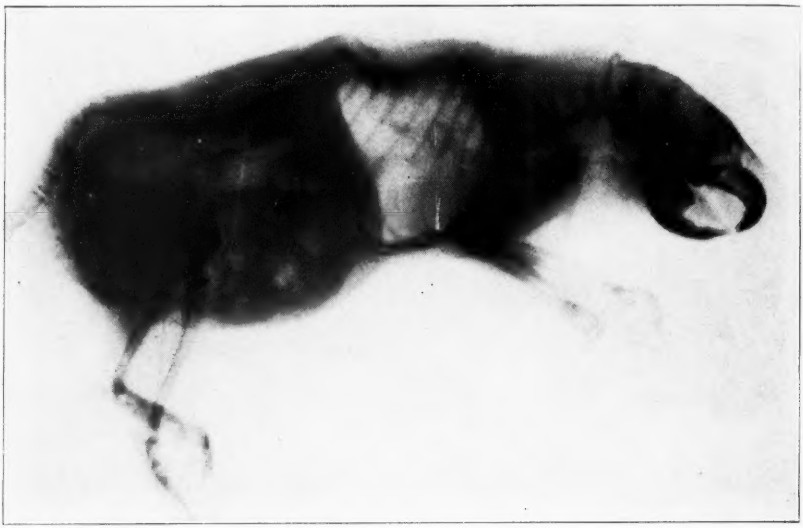

Fig. 8.—Another rachitic specimen from Experiment 2; showing the effects of a diet low in mineral content.

The question repeatedly asked is: "What is this brown stain?" The only answer that can be given at the present time is that it is not known. As all investigation is the result of accidental discovery or has a clever guess as a working basis, it is not out of place here to hypothecate a cause and offer a possible suggestion. Dr. Beust[4] has shown conclusively, as has also Dr. Caush,[5] that mottled enamel will take stain by injection of staining material into the pulp cavity. This has also been corroborated by Dr. Leon Williams.[6] Since this staining process clearly shows that there are tubuli running through the dentin and into the enamel surface, is it not reasonable to assume that, under the pressure of the blood stream, blood serum is expressed into these tubules? As the tooth ages and the enamel hardens or some changes in the diet cause better calcification, this expressed organic matter dries out or partially de-

4. Beust, Theodore: Dent. Cosmos, 54: 659 (June) 1912.

5. Caush, D.: Tr. Internat. Dent. Con., Vol. 1.

6. Williams, J. L.: J. Dent. Res., 5 (April) 1925.

cays, leaving the brown stain in the outer portion of the enamel surface.

Further experiments are in progress

Fig. 9.—Teeth of guinea pig kept on a protective diet, which included plenty of green vegetables and milk daily.

in which a study is being made of the effect of distilled water, and of water containing calcium alone, or magnesium salts alone, and also of the effect of inorganic salts of caclium and magnesium fed in solid form. These are not yet ready to be reported.

Fig. 10.—Left: Effects of keeping a guinea pig on a low calcium intake. Only enough green vegetables were included to prevent scurvy. The teeth are chalky and the enamel surface has scaled off. The coloring was a light brown. Right: The same pig two months later, after an increase in the amount of green vegetables, the animal being allowed all that it would eat. The teeth show a decided improvement, though still showing white mottles. The brown stain has disappeared.

CONCLUSION

1. It is possible to produce mottling and brown stain in the teeth of animals by lowering the calcium intake below that needed for the growing animal.

2. It is also possible to prevent mottling by supplying the calcium requirement of the animal.

3. The production of good teeth must begin during the gestation period through feeding the mother with sufficient bone and tooth forming material to meet all requirements.

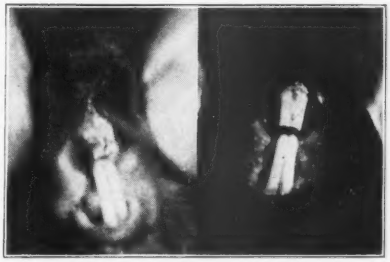

Fig. 11.—Left: Chalky and brown stained teeth, this condition being the result of a diet low in calcium. The brown markings on the teeth are typical with that appearing in children. Only sufficient green food was given to prevent scurvy. Right: The same pig two months later after the intake of green vegetables had been increased. The teeth are much improved in appearance and the brown stain has entirely disappeared.

DISCUSSION

Russell W. Bunting, Ann Arbor, Mich.: I am very much interested in what Dr. Beust has shown, for when I first began to be interested in dental histology, I remember the old altercation which existed between the Boedeckers, Andrews and a group in Europe on one side and Hopewell-Smith and Leon Williams on the other, in which one looked on the enamel as a structure having a circulatory system, and the other looked on it as

an inert substance wholly inorganic. I was very much interested in the discussion, which, as Dr. Beust has said, has been kept alive by continuous hammering at the difficult problem concerning which he has given the contribution today. The figures, pictures and drawings are interesting. Having studied enamel sections under various conditions, I also have seen the same characteristic staining of enamel here shown, but produced by a somewhat different method. I want to ask Dr. Beust how far he ascertained the character of the enamels which he showed; that is, how far he took into account the varieties of enamel which he used for experimentation. Were these good enamel or were some of them partly hypoplastic? Was that factor taken into account? I call that to mind, because the very definite conclusion which Leon Williams arrived at was that beginning caries, hypoplastic enamel and mottled enamel are identical in physical characteristics. How good were these enamels? How nearly perfect were they, if there is such a thing as perfect enamel?

Theodore B. Beust, Louisville, Ky.: I assume that the enamel which I have stained was all normal. I am confident that you can stain any young tooth. We may define as young a tooth that has not yet reached functional alinement. I have noticed that the teeth of adults are with increasing age increasingly difficult to stain. Whether we should term the condition of the enamel shown normal or not may best be answered by a comparison of the permeability of the human tooth with the permeability of the teeth exhibited by animals. In my experience with dogs, ground hogs and pigs, I find that we can stain the enamel of these animals more readily than the teeth of human beings. Animals, we assume, live in a more native state than we, and they are certainly freer from caries; yet their enamel exhibits more permeability to stains than ours. There is no doubt that the spiral and tube distribution as shown here today is the same in every human tooth, be it a so-called hard or a soft tooth. I do not believe a human tooth exists that does not exhibit the structures which I have outlined. I am aware, of course, that the distribution of enamel structures varies in different animals. I had the privilege of sectioning some teeth for Dr. Pierlé and was rather surprised at the nature of the distribution of the tubes in guinea-pigs. It differed markedly from that of the ground hog, also from that of the rat, with which I am not famliar, but which I have seen pictured. The distribution, as I have intimated, varies with the variance seen in the rods of the different animals. The structure of the enamel of both the dog and the hog more nearly approach that of the human being than does the structure of the enamel of the animals mentioned. In rodent enamel, the parallel fissure-like openings run longitudinal with the long axis of the tooth. In very young subjects, the rods stain bodily—the rods plus the capillaries. In older subjects, the capillaries only seem to convey the stain. But it is reasonable to suppose that, with exposure extending over a number of years, the rod substance would also discolor. Leon Williams used silver nitrate. I discarded this stain in 1914, as I found that it gave a diffused stain if at all prolonged and did not differentiate the calcified structure. You may take any tooth, even one with completely calcified dentinal tubules or even with completely calcified pulp cavity, and stain the whole enamel, rods and all. We infer from this that there is an organic matrix present; certainly, recent investigations point to this belief.

F. V. Simonton, San Francisco, Calif.: Dr. Beust's hypothesis is based upon intricate geometric interpretation of carefully planned experiment. Excluding the possibility that the appearances discussed may be artefactual, there seems no logical objection to this thesis. To accept it will be to add confirmation to the work of Bodecker and will aid in the understanding of commonly observed clinical phenomena. Dr. Pierlé's material adds important data to the experimental production in animals of lesions of the dental tissues. To date, students in this field have been content to designate these conditions as "caries-like" and "pyorrhea-like." The type of work being done by Dr. Beust is going to be of critical aid in a final evaluation of the diagnosis of these conditions. There is no doubt that dental lesions can be induced through deprivation of vitamins. Unfortunately, the deletion of such essential constituents from the dietary develops more profound reactions than the dental investigator wishes to produce. Dr. Martha Jones, of the pediatric department of the medical school of the University of California, and of the Hooper Research Foundation, is producing skeletal defects in animals on dietaries containing all

the essential food factors, including vitamins, but disturbed as to acid-base balance. This work shows promise of making possible the experimental production of lesions of the dental tissues in animals which remain healthy and free from any manifest disturbances elsewhere in the body.

T. D. Beckwith, Berkeley, Calif.: I was particularly interested in some of the work which was shown by Dr. Beust, because some of his work reveals certain characteristics of the dentin tubules which we thought we had seen previously, and concerning which I have said nothing, because I was not at all certain as to the nature of things I had seen. If dentin can be sectioned even by the calcified material, and if that in turn be stained with iron hematoxylin stain, which has a particular affinity, then one finds there are certain fibrillar structures which are demonstrable, and those extend through to the cementoenamel junction. The diameter of these is likewise something which we have measured by micrometric methods. It is but 2 or 3 microns thick. A series of channels were next demonstrated. Dr. Beust has not yet come to the point where he has measured these, but if they are there, then what are they there for? The microscopic preparations are fine but the diameter is exceedingly small. With regard to the by-passage of material through the junction between the two layers of the teeth, Dr. Beust has shown a probable channel. I have in mind also the fact that, during the last few years' time, in a certain German or Austrian publication dealing with dental hygiene, a series of channels have been shown. Dr. Box has shown the same thing. We, therefore, have had presented to us most interestingly this corroborative evidence.

W. P. Smedley, Denver, Colo.: I cannot speak as a histologist, but I have had a good deal of clinical experience with mottled teeth and brown stain. I assisted Dr. McKay in his early work when he was in Colorado Springs. We had, in Colorado Springs, probably the worst small locality for this brown stain in the country. Dr. McKay centered his work there, but I found among my Denver patients a number of cases of children who had been raised before the city water was put in who got their water supply from wells in the outlying portions of Denver. The teeth were marked almost exactly like those seen recently in Colorado Springs. At the time I graduated, cataphoresis was in vogue and I undertook to bleach the mottled teeth or brown stain, using 25 per cent hydrogen peroxid, with the result that brown stain was entirely removed, leaving the enamel mottled. The point that I thought would be of interest was the fact that the brown stain in all of those cases which I was able to follow up returned in the course of time, showing that whatever the chemical composition of the stain is, it is something that can be bleached and that also will return.

Weston A. Price, Cleveland, Ohio: As I had the pleasure of supporting in part the cooperation of the research commission with Dr. McKay's original work, I have always been in close touch with this problem. About ten years ago, I started some chemical studies, particularly of the water. During part of Dr. McKay's activity, in the determinations made on water sent from districts in accordance with his direction, we found a wide variance in chemical content, and the probabilities were then, in the light of our knowledge, that it was the absence of something, rather than the presence of something, in the water. That was as far as we could go. Another study which has interested me a great deal in this section, and which relates to Dr. Beust's paper, was carried on in the following manner: We undertook to determine whether or not ponderable material could be carried through apparently normal enamel, and we found it was quite easy to demonstrate that such was the case. Some substances with low atomic weight and electrolytes can be passed through enamel—sodium chlorid or sodium, quite readily. Calcium can be passed through so readily that I was able to put 7 mg. through the enamel filter in one hour. A further study along that line was particularly instructive, for we found we could take a tooth structure, dry it in the presence of sulphuric acid for a certain number of days, so it came to a fixed point of water content, and then by putting it in a solution that was of hyperconcentration or hypoconcentration in certain ions, we could change the weight. It has always seemed probable to me that part of this problem has to do with certain solvent factors in the saliva. The calcium content of the blood of such animals as Dr. Pierlé has shown this afternoon will show continually marked disturbance in calcium balance.

Theodore B. Beust, Louisville, Ky.: In regard to Dr. Beckwith's comments, I should say that tubes near the amelodentinal junction may reach a diameter of 3 microns. Near the middle portions of the enamel, generally speaking, that is decreased to 2, and, in the outer region, it is less than 1, probably going down to 0.1 micron. I have never made actual measurements. I am guessing at these measurements by comparison of the size of the tube with the enamel rod, which we assume to be between 3.5 and 5 microns in diameter. You can see the tubes very plainly in proper cross-sections, and it is easy to compare the size and draw conclusions in this manner. As regards the remarks on bleaching of brown stain, Black reported, in 1906 I think, in a publication, that he bleached the coloring matter out of the mottled teeth with gasoline. I have noticed that teeth treated with alcohol cleared up remarkably, but it did not extract all of the coloring. The discoloration can easily be duplicated by taking a partly decalcified tooth and treating it with iron sulphate, or even letting it lay in tap water in a tinned iron vessel for some days and then transferring it to a cup of tea or coffee. The iron salts will enter the enamel and, with the tannin of the tea or coffee, cause discoloration. This does not correspond necessarily to the natural condition seen in the mouth, but by way of analogy, we may draw some conclusions. Dr. Pierlé's belief that the stain enters from the inside cannot entirely be disregarded, but I consider it improbable. I should be glad to read the experiments made by Dr. Price, relating to deviations in the weight of the enamel, experimentally produced. As for Dr. Bunting's results, an osmotic flow through the enamel was obtained, I think, through certain fissures which are probably constantly present in even the most nearly perfect of teeth.

C. A. Pierlé, Canyon, Texas: The first suggestion that came to me as to how this subject might be approached, as I always have suspected there was a factor lacking in the food supply or water, was the running of the blood for calcium and also for magnesium. I laid that idea aside, for a while at least, because I had started on the other line of trying to feed it in. It is quite possible that I am wrong as to my supposition. Yet I was much interested and surprised to find that my supposition had beaten me into print. Dr. McKay's article[1] offers the same suggestion as to the manner in which the mottling takes place, contrary to what Dr. Beust seems to think about it. I am not sure I am right about my supposition as to its occurrence, but I do know that those brown teeth are not brown when they erupt. It comes into the teeth after the tooth has erupted, and rarely does the brown stain begin to show until the tooth has reached almost its normal size. It is true that the tooth, when it erupts, must be mottled with a paper white mottling or it will not take brown stain. Whether this stain comes in on the tooth afterwards from the outside, I do not know, but I am inclined to think it comes from the inside out, and is certainly working in that direction, Dr. Beust and I and the others will some day meet. I intend to follow the suggestion as to looking into the blood serum, or rather into the calcium content of the blood, not only in the rats but also in children with brown teeth, and especially those children who are just developing brown teeth, if I can get a specimen of blood. I am having difficulty in getting specimens to work with right along. I would have had more done on the actual chemical analysis of brown teeth, if I could have obtained brown teeth, but the owners won't part with them.

1. McKay: Dent. Cosmos (September).

DENTAL RESERVE CORPS TRAINING

By FRANCIS A. BOYLAN, D.D.S., Minneapolis, Minnesota

IN training officers for service under the National Defense Act, the fact is borne in mind that no branch of the service should be underserviced in time of combat if maximum efficiency is to be attained. Winning a war is not accomplished by the effort of one arm or branch of the service but requires the military effort of all personnel. It is quite necessary, then, that the dental officer, if he is to carry out his military rôle, get enough military training to carry out the military prerequisites of active service in time of war.

The training the student who is in college gets before he receives his commission as a first lieutenant in the Reserve Corps is excellent, and its basic treatment of training does not have to be supplemented by further training for some years following. Neither does the training of a dental reserve officer who served a sufficient length of time in the past war need much supplementary work following closely the end of this war. As time goes on and new things creep in of a military manner, the mind must be refreshed with active training and study of newer things. Esprit de corps and morale can be easily lost by a dwindling interest because of a lack of training facilities and appropriations that do not permit the training of all officers who want it; and, on the other hand, personal efficiency cannot be gained by the officer who uses his commission as an ornament of rank instead of a design of accomplishment. It would seem a happy medium if those who wanted a yearly training period of fifteen days could have it and those who need it would accept it.

The fifteen-day period of training allotted yearly to the dental reserve officer serves as a period of what one might term a postgraduate effort in learning new things military and consolidating mentally the old.

The Reserve Corps, with all of its auxiliaries, is supposed to be our third line of defense, and all branches of this Corps try to train as many officers yearly as congressional appropriations allow. In the table of army organization, the Dental Reserve Corps is a branch of the medical department and trains under the supervision of that department.

Under the existing Tables of Organization, the total strength of the Dental Reserve Corps is 5,188. March 1, this year, the strength of the Corps was 4,024; so, roughly speaking, 80 per cent of the Corps was filled. That represents nearly a 10 per cent increase in a year, and according to figures in

the Surgeon General's office, 80 is a much higher percentage than any other Reserve Corps of the Medical Department. Of the 4,024 commissioned officers, the number in each grade is as follows: 7 colonels, 54 lieutenant colonels, 336 majors, 1,036 captains and 2,591 first lieutenants. In the last three grades mentioned, 51 colored officers are included.

Lately, there has been a suspension of appointments in the Dental Reserve Corps in the grades of colonel and lieutenant colonel, in view of the large number of officers in those grades in proportion to the requirements. This suspension applies to applicants for the foregoing grades who have had World War service, but does not apply to appointments or promotions of those federally recognized as colonels or lieutenant colonels in the Dental Corps of the National Guard.

There is no objection to majors of the Dental Reserve Corps being given an opportunity to qualify for a certificate of capacity, with the understanding that promotion to the grade of lieutenant colonel in the dental section will not be made until the suspension of such promotions is removed and an appropriate vacancy exists in each case.

In 1923, 84 officers received training; in 1924, 217, and in 1925, 304. The principal stations at which this training was given were Fort Bragg, N. C.; Carlisle Barracks, Pa.; Camp Custer, Mich.; Fort Des Moines, Iowa; Camp Devens, Mass.; Fitzsimons General Hospital, Denver, Colo.; Fort Benjamin Harrison, Ind.; Camp Knox, Ky.; Fort Leavenworth, Kan.; Letterman General Hospital, San Francisco, Calif; Camp Lewis, Wash.; Camp Meade, Md.; Fort Omaha, Nebr.; Fort Sam Houston, Texas; Fort Sill, Okla.; Fort Snelling, Minn., and Camp Sparta, Wis.

The plans for 1926 fifteen-days training contemplate that approximately the same number will be ordered as in 1925, that is, about 300. This appears to be a fairly accurate estimate, as the funds for 1926 training camps is the same as for 1925. It is believed that the stations above mentioned will again be the centers for this training. An effort is going to be made this year to give training to those dental reserves who have not been to camp within the last two years. If applications are received from enough officers in this class to fill our quota, none who had training in 1924 or 1925 will be ordered this year.

At Fort Snelling last year, the fifteen-day training period here discussed was July 5 to 19, inclusive, and was attended by about sixty dental reserve officers from ten states, mostly in the 7th Corps Area. Their training, with the exception of a few lectures on dental administration, etc., was the same as that of the medical officers in camp. In time of combat, especially in the zone of advance, a dental officer must be equipped to help the medical officer in first aid and in many other of his duties. The training day, Saturday excepted, begins at 6 a. m. and is usually concluded by 4 p. m., and as time is limited, the training is as intensive as possible.

An average day's program opens at 6 to 6:10 a. m., with calisthenics. From 7:00 to 8:00 follow lectures on ad-

ministration and then close-order drill from 8:15 to 9:10. The rest of the day might be taken up in a composite program subject to changes in schedule as follows:

9:15-10:00	Customs of the service.
10:00-10:30	Quiz on all preceding lectures.
10:30-11:15	Tactical employment of collecting company.
11:15-12:00	The infantry division in combat.
1:45- 3:30	Courts-martial. Field sanitary appliances. Mobilization plans.

Just before demobilization, a terrain exercise, with a problem for solution, is considered, and the training period is over.

Aside from the military training which the attendant enjoys, there are the social side and outdoor activities that appeal to the dental officer. One usually runs across comrades of other days, and many reminiscent hours are spent together. To many, this period of out-door activity is a change and vacation, and one returns to his work refreshed physically and mentally—and undoubtedly, patriotically.

A word should be added about the officers and men of the regular army who conduct these camps. It certainly is apparent that they leave nothing undone to make these training periods and camps as helpful and enjoyable as possible to the reserve officer. Having attended three successive camps at Fort Snelling, I am convinced that each succeeding camp has been better than its predecessor, and much thanks for this should be given to Col. Jere B. Clayton, corps surgeon of the 7th Corp Area.

It would be an excellent thing for as many reserve officers as possible to avail themselves of this training in 1926, and to work for the betterment and advancement and strength of their corps in the future. It should be the patriotic goal of the profession to see that its reserve corps allotment is full and that representative men make up its full quota. The better the individual, the better the corps.

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Editorial

THE COMPENSATIONS OF PROFESSIONAL LIFE

We sometimes hear a man say that if he had his life to live over again, he would never be a dentist. Probably no pursuit is wholly ideal, and yet it may be well for the professional man to take note at times of the compensations which his calling presents, to the end that he may get more satisfaction in his work and proceed to his daily task with greater joy.

The professional man comes more intimately in touch with the vital interests of mankind than does the ordinary business man. If he is the right kind of professional man, he gets a firmer grip on the sympathies of the people and meets them on a more stable basis of friendship and fraternity. To minister to an individual in a professional way is to make a stronger sentimental appeal to him than to sell him commodities. The one occupation may be as honorable as the other, but the close personal relationship of professional service forces a distinction which cannot be gainsaid.

The practice of dentistry is particularly fitted to develop an *entente cordiale* between the practitioner and the patient. The former is contributing concretely to the physical well-being of the latter, and frequently an entire family is receiving service which tends to their daily comfort and peace of mind. The man who is delivering this service naturally achieves a hold on the appreciation, and even on the affections, of the people, which ultimately binds them together in a community of sympathy and good will that can never be approached in a mere business relationship.

In life, the chief rewards are not those of a financial character. The mere accumulation of wealth seldom in itself brings happiness, and the problem of administering great wealth judiciously is frequently a serious one. Money, therefore, as money, has almost as great a potentiality for unhappiness as for happiness, and so we must turn to other things in seeking the real rewards of life.

Probably one of the greatest rewards we get is the sense of satisfaction which comes from an honest and successful effort to render constructive service to our fellowman. Particularly is this true when this service represents a distinct contribution to the physical and mental well-being of those we are called on to serve. This is no visionary or far-fetched concept, but a sublime and concrete fact, capable of practical demonstration in the lives and experiences of all those who practice a profession. It is a daily concomitant of the man or woman who labors unselfishly for the good of humanity, and, in the end, it brings the greatest solace for some of the hard experiences of life.

In this particular, dentistry holds high rank as a calling calculated to bring its full meed of satisfaction. To take from the drawn face of agony the lines of suffering; to see the pale countenance of a little child light up with relief; to change a tear to a smile, and a frown of pain to the blessed balm of comfort; to go through life ministering concretely and effectively to the betterment of human kind; to know at night when you lay your

head on the pillow that during the day you have sent one poor sufferer happily on his way; to feel the thrill of that close and intimate relationship to your fellowman which comes only from serving him in a personal way; to see growing up around you the friendships of men, women and children, and to know in your heart of hearts that you are being made a part and parcel of their very lives—all of this is better than wealth, better than climbing the mountain tops of commerce and trade, better than leading a legion to battle, or claiming the plaudits of the multitude. For serene satisfaction in declining years, there is nothing equal to the solace of knowing that you have contributed your full quota to the physical and mental benefit of your fellow man, and when the sum total of all we have achieved in life is measured up and evaluated, it will be found that the only thing really worth while is the contribution we have made to the welfare of others.

In professional life, we have a greater opportunity of serving acceptably than in any other calling, and to serve acceptably is to reach the acme of achievement in all our human endeavors.

When a professional man proclaims the fact that he is discontented with his calling, it is evidence either that he was never intended for a professional man, or that he has failed to get a full vision of the possibilities of what a true professional life holds for him.

Let such a man take stock of his privileges and enter into the heritage which has been left him from all the ages since men began to practice professions. Let him study the traditions of his calling, and the careers of the noblest men in it, and see if thereby he cannot catch a vision of what real professional life may mean to him. In the glorious records of the pioneers who gave dentistry a status in the eyes of the world, let every dentist take heart and inspiration, and let it be the pledge of every man practicing today that he shall do his part in placing the banner of his profession a little further aloft, and thus do full credit to the memory of the splendid men who gave to us the foundation of what we are enjoying today.

The compensations of professional life far outweigh its handicaps, provided the practitioner takes advantage of his opportunities, and lives a life of sacrifice and service. In this way only can he win the greatest success or achieve the surest happiness.

THE HOUSE OF DELEGATES

There seems to be a prevalent impression that the House of Delegates will not have much business this year, on account of the fact that the usual scientific and clinical features of the meeting are to be turned over to the Seventh International Dental Congress; but the fact must be borne in mind that there is much business of importance to be transacted by the Delegates, and they should go to the meeting prepared to devote their best energies to the various problems to be presented. The fact is that when men are appointed delegates to the American Dental Association, they should accept their appointment with all seriousness. They should study the needs of the Association most carefully, and thus be able to vote intelligently on every question brought up for consideration. The office of a delegate to this great organization is at the same time a signal honor and a grave responsibility. No man should permit himself to accept it without a due appreciation of his obligation in the matter. He owes it to his own particular constituency and to the Association itself to make himself familiar with everything bearing on the best interests of the organization, and he should be faithful in the performance of every duty connected with his appointment.

The coming Congress promises to be the greatest meeting in the history of dentistry, and every effort should be made to magnify its importance and its interest, but this should not in any way interfere with the work of the House of Delegates in the performance of the necessary business of the American Dental Association.

The President, Sheppard W. Foster, has arranged for two meetings of the House, one Saturday forenoon, August 21, and

one the same afternoon. All meetings are to be held at the Bellevue-Stratford Hotel.

Most of the state societies have by this time appointed their delegates, and it simply remains for those chosen to have a keen appreciation of their obligation and come to Philadelphia prepared to take an intelligent part in the deliberations.

INVITATIONS FROM THE GOVERNMENT OF THE UNITED STATES TO FOREIGN COUNTRIES TO SEND DELEGATES TO THE SEVENTH INTERNATIONAL DENTAL CONGRESS

The Secretary-General of the Congress, Dr. Otto U. King, has received word from the State Department at Washington that, in pursuance of the Joint Resolution of Congress, approved May 3, 1926, invitations to participate in the Congress have been extended to the following Governments: Albania, Argentina, Austria, Belgium, Bolivia, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Cuba, Czechoslovakia, Denmark, Dominican Republic, Esthonia, Finland, France, Germany, Great Britain, including the governments of the British dominions, Egypt, Greece, Guatemala, Haiti, Honduras, Hungary, Free State of Ireland, Italy, Japan, Latvia, Liberia, Lithuania, Luxemburg, Mexico, Morocco, The Netherlands, Norway, Panama, Paraguay, Persia, Peru, Poland, Portugal, Rumania, Salvador, Kingdom of the Serbs, Croats and Slovenes, Siam, Spain, Sweden, Switzerland, Turkey, Uruguay and Venezuela.

If any skepticism has existed as to the international character of the coming meeting, it will be necessary only to glance at this list in order to dispel all doubt. Seldom has any government taken cognizance of a professional meeting in the signal manner in which the Government of the United States has recognized the Seventh International Dental Congress, and the profession of dentistry hereafter must ever hold itself under deep obligation to Congress and the State Department for their loyal support of this

meeting and the very cordial attitude which they have displayed toward it. It would seem now that nothing can stand in the way of a very wonderful success for the Congress. The Government has done all in its power to promote this great event, and now all that remains is for the profession to do its share. That the profession will do this, we are wholly confident.

READ GOOD BOOKS

Read good books. There are many of them. And of all people who should read them the professional man should head the list. He needs the kind of culture that comes from a familiarity with the best literature. It broadens him and makes of him a better man. This does not mean that he must confine himself to the ancient classics, though a liberal selection from them will do no man any harm.

There is so much literature being turned out today that it cannot all be bad. The simple poems of Edgar Guest are many of them modern classics, as were the poems of James Whitcomb Riley. Whatever grips the heart of humanity and makes it beat in harmony with the universal brotherhood of man is a classic. One of the greatest poems ever written dealt not with heroic deeds, or war or adventure. Gray's "Elegy" painted a picture—the most accurate in all literature—of the common people, and it will continue to move the emotions as long as poems are read.

To cultivate a taste for good literature is to store up resources of satisfaction and happiness for life, no matter how long life may last.

DEPARTMENT OF DENTAL HEALTH EDUCATION

FORSYTH PROGRAM BASED ON TEN YEARS' EXPERIENCE*

By HAROLD DeWITT CROSS, D.M.D., F.A.C.D., Boston, Massachusetts

THE work of the Forsyth Dental Infirmary was started ten years ago with the idea of establishing and carrying out preventive policies. Extension for prevention in the preparation of cavities and cleaning of teeth were practically the only phases then given much attention. Consequently, work was begun by carrying out orthodox filling and treatment of root canals and routine cleaning. Early attention or care of primary teeth or filling of fissures and pits was not practiced ten years ago, to any extent.

The beginning of the present plan to give early care was developed about nine years ago, when it was recognized that, on account of failure to bring children to the clinic until they were from 14 to 15 years of age, most of the serious damage to the teeth had already occurred. All of the subsequent developments in routine have been based on this one idea of having an opportunity to care for the teeth before serious trouble arose and before the developmental (organic) fissure or pit had time to become enlarged.

Upon this one feature has been placed the chief reliance, and it has overshadowed the technical cleaning and tooth brushing as a means of accomplishing satisfactory end-results in regard to the control of caries.

The various activities making up the program or policy under which the Forsyth Dental Infirmary is operated are listed herein, together with a brief description of each.

1. All clinics are coordinated with routine examination for dental defects, diseased or enlarged tonsils and adenoids, height and weight of patient, arch width, endocrine deficiencies, diet and habits for all cases. In suitable cases, advice is given as to treatment in dental, tonsil and adenoid, pediatric, endocrine, dental orthopedics or food and habit clinics.

All of the clinics are conducted as one, with several branches, and are coordinated to the extent that, as a routine measure, each child who enters for whatever particular type of treatment (except for emergencies) is required to

*This paper is a part of a symposium, the remaining papers of which will be published in a subsequent issue, with the discussion.

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Sixty-Seventh Annual Session of the American Dental Association, Louisville, Ky., Sept. 22, 1925.

go through all of the clinical examinations. In this way, all necessary data pertaining to an individual child are revealed, and correlated, without reliance either on the information volunteered by the patient or on the casual notice of the doctor in some clinic detecting something that should be done in another.

Patients showing evidences of malnutrition, such as approximal or cervical caries, underweight, endocrine dystrophies or generally poor physical condition are recommended to the suitable medical clinic for treatment.

2. A physical examination and treatment from a nutritional standpoint is given all patients showing active caries or those underweight, in pediatric, endocrine and food and habit clinics. All medical treatment, including food and habit regulation, is preceded by a complete physical examination, so that the exact condition of each child is known, in order not to carry out any treatment that might be contraindicated from a systemic standpoint.

So far, no particular indicator or accompaniment of defective teeth has been found. Attempts to correlate weight, endocrine deficiencies or diet and habits has not yet been of sufficient definiteness to be relied on. Of these three, the indications appear to point more to food, from the standpoint of the acid-alkaline residue, and endocrine factors, when thoroughly analyzed, and these, together with some others, are being investigated at present.

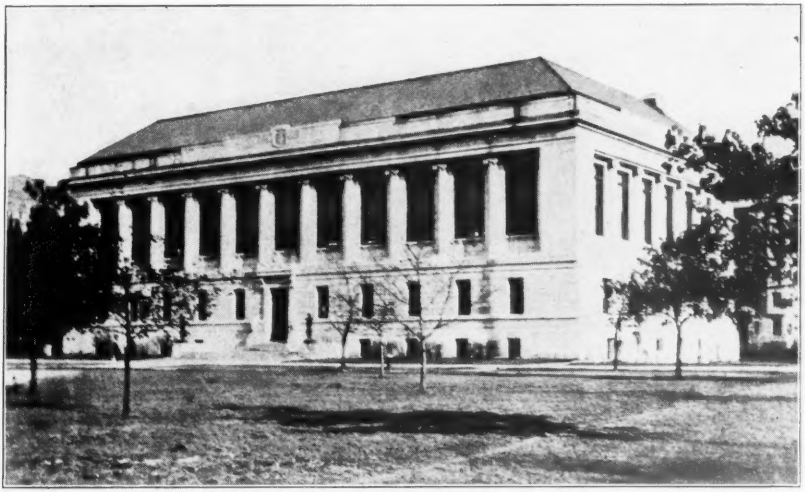


Fig. 1.—Forsyth Dental Infirmary.

3. No new patients over 6 years of age (or with first permanent molars showing extension of small organic—developmental—fissures) are treated. This plan has been carried out to the extent of approximately 75 per cent for the last four or five years, but a very definite advance has been made during the last year, when practically every

new patient has not been over 6 years of age. This has made it possible practically to eliminate all root canal work, as teeth that are carefully filled when the cavities are of a simple character do not come to require pulp and root-canal work until very late in life, if at all.

The reason that this plan of treating every child not later than at 6 years of age has not been more generally accomplished before is due to the difficulty of inducing parents to let their children be cared for before they have some definite tooth troubles such as a large cavity or a toothache, and of interesting nurses, physicians and dentists from the same standpoint. Thorough and as nearly lasting work as possible is done, and attempts are not made to "save" teeth by the uncertain methods of pulp capping; consequently, there are none to go wrong because the teeth are filled when the cavity is small. Also great efforts are made, by cutting out the entire fissure, to do the filling as thoroughly as possible, in order to avoid replacements and patching to as great an extent as possible.

4. Large numbers of children, from 2 to 3 years of age, are treated in order to preserve the primary teeth. It is the aim to fill all cavities within six weeks after eruption, whether in primary or in secondary teeth. It is not yet possible to do this for primary teeth to the same extent as for secondary, because of the difficulty of getting in touch with children of this age. However, through the baby hygiene and preschool age children's associations, a definite gain is being made each year, and large numbers of this age are now treated. More time probably will be required to place the treatment of primary teeth on a par in numbers with that of the first permanent molars than was required for secondary teeth, but it will undoubtedly be accomplished within a few years.

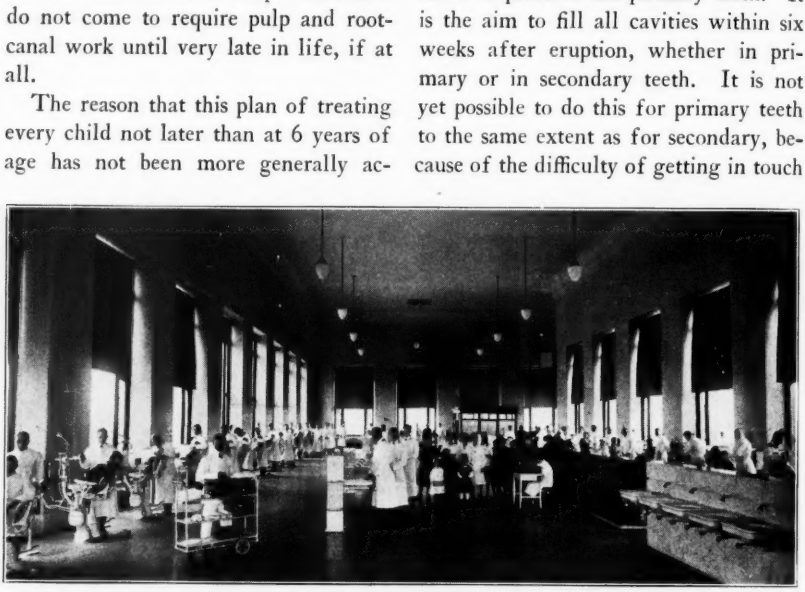


Fig. 2.—View of clinic, Forsyth Dental Infirmary.

5. The extraction of first permanent molars has become nearly obsolete, being done now only for those who come from outside districts and have not had the advantage of early treat-

ment. One first permanent molar to every three teeth was extracted in 1915, one first permanent molar to every 200 teeth was extracted in 1925.

This ratio of one first permanent molar to every three teeth extracted was gradually reduced, by early attention, to one first permanent molar to every five teeth in 1918, and in 1924 only one tooth in each 200 extracted was a first permanent molar. This applies to children from the same districts and who received relatively early care. During the first three years, at least 50 per cent of the first permanent molars were given root canal treatment, while since then this form of treatment has been reduced to zero. This means that the only first permanent molars that require extraction now are those in the mouths of children who did not receive early care, for one reason or another.

Another phase is of interest also: This early care especially of the primary teeth, has resulted in a considerable reduction in the incidence of tonsil complications, it having been early demonstrated that about 30 per cent of patients with enlarged and infected tonsils did not require tonsillectomies after the teeth had been attended to. This percentage, of course, would be much increased if the diseased tooth conditions were prevented from occurring at all.

Cervical adenitis also is rarely seen in those children whose teeth are maintained in good condition.

6. It is planned to see children at approximately the ages of 2, 4, 6, 9 and 12 years, for routine filling of fissures and pits (organic defects). To see all cases for cleaning and examination, once each school year, and give incidental filling and medical (nutrition and endocrine) care. The results obtained by the early filling of fissures and pits within a short time after the eruption of the tooth have prompted the adoption of a plan to see children only at stated intervals for "routine" fillings. These intervals are not determined by the calendar, age or school grade, but according to the eruption of each corresponding pair of teeth, and sufficiently early to forestall any possible rapid extension of the developmental defect. It is necessary, to make the work successful, that this period be sufficiently short, and the nurses are instructed that within six weeks is the only safe time. In this way, any detailed school examination is unnecessary. All that is required is for the nurse to keep watch for new teeth, of which the child is usually aware, and see that all of these new comers receive prophylactic care, with fissure and pit fillings if required.

In general, the ages at which we may expect to find erupting pairs of teeth are 2, 6, 9 and 12 years, varying in each instance according to the physiologic age and development of the child. Thus, only three periods of visits for fillings are needed during the school life of the child.

Each child receives a prophylactic treatment once each year, at which time special appointments are made if any fillings require replacement, or any new (approximal or cervical) cavities are noted. The number of such cavities is quite small except in cases of children suffering from a serious lack of lime salts, or with endocrine complications. In these instances, the child not only has the fillings placed, but also is given appropriate medical attention from a nutritional standpoint, endocrine deficiencies and faulty diet and other deleterious habits being corrected.

This long interval between routine visits for fillings is made possible only on account by the thorough type of work (filling) originally done for cases begun at not later than 6 years of age. The operations are thorough, owing to the cutting out of pits and fissures and to the fact that there are no deep cavities, capped pulps or conditions that make fillings short lived.

7. All patients are dismissed at 12 years of age. While it was the original intention to care for children up to the sixteenth year, and this was necessary when "orthodox" dentistry was practiced, it has been found that there is now no dental reason for continuing this care for children beyond the time the second permanent molars are in place and fissures and pits are filled. The only exception is made in the case of children with marked malnutrition, but, with the Forsyth plan, these patients would ordinarily have been brought up to a standard of nutrition before their twelfth year, so that during the next few years, there should not be much occasion for repair or replacement of fillings.

8. A prenatal clinic is carried on to aid in developing good dental organs for the child by oversight and treatment of prospective mothers in medical, dental, endocrine and food and habit clinics.

This work is being carried out for prospective mothers in cooperation with several of the prenatal activities of the city, and is as nearly early treatment and prevention as we may expect to attain at the present time.

The aim is to preserve the mothers' teeth, by dental care, in a state of nontoxicity to her system and to regulate her food and habits for adequate mineral and vitamin metabolism and to give her endocrine organs the necessary support, to enable her to give the child's teeth every possible advantage of development.

It is, of course, too early to determine the results of the antenatal dental care phase, or to attempt to draw conclusions from either the effect of the endocrine or food and habits treatment and supervision. It is reasonable to expect an improvement in the dental organs from all of these activities if, as is almost inevitable, they result in improved nutrition from the standpoint of mineral metabolism.

9. The Forsyth plan, while extremely simple and nontechnical in character, is giving "end results" at 16 years of age for teeth that have had the minimum of dentistry, as early repair work, and four first permanent molars with vital pulps and small fillings are the satisfactory results. This is a result that technical (orthodox) dentistry has never produced and never can. In a recent checkup, it was found that 82 per cent of the children in the eighth and ninth grades who received treatment in the first, second or third grades have four first permanent molars in good condition; 11 per cent have three first permanent molars, and the balance are those who either were a little early in cutting these teeth or were the last to receive treatment at the end of the third grade.

If we can obtain, in 82 per cent of cases, a result such as this, when only a portion received sufficiently early care, we certainly can expect to raise the proportion very easily if we can treat every child not later than at 6 years of age.

End-results in terms of good teeth, i.e., all teeth present with vital pulps and with only small fillings, have not

been the usual attainment of dentistry, but that this condition may be obtained to an extent well over 82 per cent is the natural deduction to be made from the results of the last few years' work in the Forsyth clinics.

This one phase, early treatment of primary and secondary teeth, if universally advocated and adopted in both clinic and private practice would, in a few years, eliminate the necessity for a great part of the present-day repair and patch work, and bring dentistry nearer the goal of prevention than any other procedure that is known at the present time.

ROCHESTER DENTAL DISPENSARY*

By HARVEY J. BURKHART,† D.D.S., LL.D., Rochester, New York

IT is not possible, in the time which has been allotted to me, to go into detail to any great extent with reference to the founding and work of the Rochester Dental Dispensary. In order that you may have something of a background and be able to understand the work of the institution and the activities connected with it, I will give you a brief historical view of its many activities.

The Rochester Dental Dispensary was founded in 1915 by Mr. George Eastman, of the Kodak Company. In making the gift, Mr. Eastman agreed to erect and furnish a building and provide an endowment of $750,000, if, at the end of five years, the work proved to be satisfactory. The building was erected in 1916, and with the equipment cost about $500,000. After the work of the dispensary had been going on a little more than a year, Mr. Eastman was satisfied that the work fully met his expectations, and turned over to the board of trustees the sum of $750,000, promised at the time of the founding, and in addition, for good measure, $250,000. Since that time, he has given approximately a million dollars more, making a permanent endowment, with accumulations, of more than $2,000,000.

One of the conditions of the founding of the dispensary was that Mr. William Bausch was to secure at least ten citizens of Rochester who would be willing to contribute $1,000 a year, for five years. Thirteen citizens met this condition and signed a five years' contract, which was, subsequently extended to six years. At the end of the first six years' period, the pledges were renewed for another period of five years. In addition to the regular trustees, there are at present two honorary contributing members. The business of the dispensary is managed by a board of trustees, composed of twelve business men, one lawyer, the superintendent of schools and the director.

Another provision of the gift was that the City of Rochester should contribute not less than $12,000 a year for five years, to carry on prophylactic work in the schools. In 1916, a contract was made with the city to contribute $20,000 a year for the first

*Address given at the Medical College of Virginia, June 1, 1926.

†Director of the Rochester Dental Dispensary.

five years. At the expiration of that contract, it was renewed for another period of five years, at an increase of $5,000 a year, or $25,000 a year in all. No part of the contribution made by the city is used to defray the expenses of the work of the dispensary, and the municipality has absolutely nothing to do with conducting its affairs.

Fifty of the dental unit equipment that were installed at the beginning were donated by Mrs. Adelaide Ritter Shumway and Mrs. Laura Ritter Brown, in memory of their father, the late Frank Ritter. Since that time, they have agreed to supply the additional number required to furnish the dispensary. In all, their donation will amount to approximately $50,000. Mr. William Bausch, president of the board of trustees, provided the furnishings and decorations of the children's waiting room, at a cost of $3,500, and Mrs. Rudolph H. Hofheinz, in memory of her husband, the late Dr. Rudolph H. Hofheinz, a member of the first board of trustees, furnished the required equipment for the research laboratory, at a cost of about $3,500.

MR. EASTMAN'S OBJECT IN FOUNDING THE ROCHESTER DENTAL DISPENSARY

In the founding of the Rochester Dental Dispensary, Mr. Eastman recognized that the prevention of disease is of more importance than its treatment. While relief and reparative work is necessary, the ultimate object sought is the development of methods and practices to prove the value of preventive dentistry. The education of parents and children is regarded as an important development in accomplishing this object.

It is planned, through education, to have mothers bring their babies to the dispensary as soon as the first tooth erupts, and, by follow-up methods, to retain the child as a patient until the age of 16, in the belief that, by this scheme, opportunities for experimentation and study will be given that could not be obtained in any other way, and that it will finally result in the standardization of filling materials and methods of procedure that will be of tremendous benefit to coming generations.

Only children up to the age of 16 are received for treatment. Rules for admission have been adopted, based upon the weekly income of the family. They are as follows:

Two in family, $10 per person per week; three in family, $9 per person per week; four in family, $8 per person per week; five or more in family, $7 per person per week.

DENTAL DEPARTMENT

There are employed in this department twenty-eight dental graduates. As you are aware, the whole thought and scheme of the work in the dental department is preventive rather than reparative; but this ideal will not be reached for many years to come, so it naturally follows that the major part of the work done in this department consists of fillings, treatments and the various other dental operations necessary in the doing of rescue and relief work. For some years, it has been our practice to clean out and fill the fissures and sulci of permanent molars and bicuspids with cement or treat them with silver nitrate. Of course, if decay is present, permanent fillings are inserted. Very gratifying results have been observed from this practice. Various new methods are being constantly tried, and it is the aim of those in charge of the work to make it as nearly painless as

possible. Every effort is made to have the operations performed in a thoroughly skilful manner. As far as possible, the latest safe methods are employed in the various departments, so a high standard of efficiency will be maintained and the best possible service rendered in children's dental work.

EXTRACTING DEPARTMENT

There was a large increase in the number of teeth extracted last year, because fewer infected teeth were treated. Where any considerable infection was observed, it was thought best to be on the safe side, and extract, rather than carry the child through a prolonged period of treatment, and run the chance of infection being carried to and causing disturbance in some remote part.

Every effort is made in the conduct of this department to do the work painlessly, and to remove the fear of the operation, as nearly as possible, from the child's mind, by kindly and careful treatment and the administration of general and local anesthetics.

During the year, through the courtesy of the medical department of the Kodak Company, we have sent the more experienced operators to the Kodak plants for the purpose of doing extracting for adults. Much benefit has been derived, not only by those who have received this service, but also because of their increased experience, by our operators in this large and varied clinic. It should also be stated that an adult extracting clinic, financed by Mr. William Bausch, has for some years been conducted at the General Hospital. This work has also been done under the direction and supervision of the dental dispensary.

Dental Hygienists, Rochester Dental Dispensary, at Kodak Park Works, Eastman Kodak Co., 1926.

ORTHODONTIA DEPARTMENT

Seven dental graduates are employed in the orthodontia department. It is planned to extend greatly the activities of this department as soon as operators can be trained for this particular work. At present, there are 298 cases under observation and treatment. Models have been constructed and pictures taken so that a comparison can readily be made, showing the wonderful results that have been obtained. A marked improvement in the appearance of children under orthodontic treatment is easily observed. The splendid results

obtained in this department are most gratifying.

On account of the length of time necessary to straighten teeth and the expense of having it done in private dental offices, probably none of the children treated here could have this work done. There is probably no other dispensary activity that is so popular as the work done in this department, in remaking and beautifying faces that would otherwise be unattractive. Not the least of the benefits of the orthodontia work results from the restoration of normal occlusion and the widening and spreading of the arches, for the improvement of speech and the comfort of the child.

ROENTGEN-RAY DEPARTMENT

The work of the roentgen-ray department has increased considerably, 6,161 pictures being taken last year. The work is very valuable because of the assistance given in the diagnosis of obscure and difficult cases. A large part of the work in this department consists of taking photographs of the jaws to ascertain conditions of the roots of the teeth before and after treatment. There is also much work done in taking pictures of the sinuses of the head, to determine whether some of the disturbances may not be due to abnormal conditions of the sinuses.

RESEARCH DEPARTMENT

Mrs. Rudolph H. Hofheinz, who furnished the equipment, has evinced great interest in the research department, and, during the year has contributed a substantial sum for research work, to Dr. Charles F. Bodecker, of New York, formerly of Berlin, for research work on caries of the teeth. Dr. Bodecker is a highly educated and trained histologist and bacteriologist, and much valuable information should be obtained on this important subject through his investigations.

It is gratifying to be able to report that, last autumn, Dr. Philip Jay was engaged by the School of Medicine and Dentistry of the University of Rochester, to carry on work in dental research.

SURGICAL DEPARTMENT

During the year just closed, there were 1,682 tonsil-adenoid operations performed in the dispensary. Of this number, 990 were certified by Dr. Goler and his staff of physicians and nurses, for which the City of Rochester paid the amount of $4,950. The total expenditures in this department for 1925 were $13,767. There was received the sum of $8,518, leaving a deficit of $4,249, which was paid by the dispensary out of its income, for this service.

You will no doubt be interested in knowing the extent of the tonsil-adenoid work being done in the hospitals of Rochester and the Dental Dispensary. According to figures furnished by the health bureau for 1925, there were performed in the various hospitals of this city 2,411 private tonsil-adenoid operations and 705 in the wards, making a total of 3,116. During the same period, 1,682 tonsil-adenoid operations were performed in the Rochester Dental Dispensary, making a grand total of operations of this nature for the city of 4,798. You will notice by the figures that the Dental Dispensary is doing almost two and one-half times as many ward operations as all of the hospitals combined. Notwithstanding the largely increased amount of tonsil-adenoid work which is being done in this city, it is impossible to keep pace with the requirements and the demand for this service, unless some arrange-

ment can be made with the various hospitals to increase largely their work in this particular. The Dental Dispensary has practically reached its limit as far as its facilities are concerned for doing this work, and some steps should be taken to induce the other hospitals to do more of it.

The dispensary and those connected with the surgical department are to be congratulated on the splendid service rendered during the year, and the favorable comment which has been received from medical and dental journals, public health authorities, the Red Cross and many others. Numerous requests are being received from all over this country and abroad for information concerning this clinic. There has been widespread interest manifested in the manner in which the work is being performed, the plan of organization and many other matters in connection with it.

It will be recalled that, on account of Mr. Eastman's appreciation of the necessity for and value of tonsil-adenoid work, for the improvement of the health and general condition of the children of this city, an intensive clinic was inaugurated during the summer of 1920 and a general clinic at Convention Hall, the hospitals and dispensary in 1921, at which time more than 10,000 operations were performed. The work of these clinics is one of the most outstanding features of the health work done in Rochester, and its contribution to the improvement of the general well-being of the children of this city, while difficult to estimate at this time, holds the promise of tremendous good.

In the autumn of 1921, and again in 1925, and since that time, funds have been provided by the community chest for reexamination of the children operated on during the various clinics. Valuable information and reliable data were obtained as to the benefits of the operations. Practically without exception there has been a very marked improvement in the general health and appearance of the children on whom tonsil-adenoid operations were performed.

Probably the most beneficial result that will be obtained from the tonsil-adenoid clinics is the education of the public to the great need for this service, and especially in calling the attention of the parents to physical defects and needs of their children.

SOCIAL SERVICE DEPARTMENT

The social service department is conducted in a broad, reasonable and efficient manner. It is the aim of this department to see that none receive treatment in any of the departments of the dispensary whose circumstances will permit them to employ a regular medical or dental practitioner.

Many difficult problems are presented in coming to a just determination of those eligible for treatment, but where any question arises that seems difficult of solution, the benefit of the doubt is always given to the child. It is our purpose to favor, as far as possible, the children of the families of the great so-called middle class of people, because the rich and the poor always have available to them, in nearly every community, the best medical and dental service. Emergency cases receive first consideration and attention regardless of the rules for eligibility. After relief has been given, a careful investigation is made to ascertain the financial status of the family of the applicant, before the child is listed as a permanent patient.

The rules for treatment have been

changed a number of times since the dispensary was organized, to meet the changing economic conditions. As an evidence of the foresight and wisdom of the board, it should be said that the present rules governing the admission of children for treatment are practically in accordance with the estimate of the cost of decent living made by the United States government authorities, the Red Cross and other competent welfare agencies.

WORK IN PUBLIC SCHOOLS AND INSTITUTIONS

Prophylactic or teeth cleaning work has been done in the schools of Rochester, the orphan asylums and various other institutions for more than nine years, by squads of dental hygienists under the supervision of licensed dentists. From fifteen to twenty-five graduate hygienists are employed in the Rochester schools on full time. They are divided into squads of from two to ten, depending on the size of the school to be visited. They are furnished with portable equipment, consisting of a chair, cabinet, foot engine, sterilizers, towels, etc. The equipment is sent by truck from one school to another. When a squad visits a school, the one in charge first obtains the card file and arranges a schedule with the principal. The children in the kindergarten are usually treated first, and then the grades are taken, in rotation. There is no fixed rule, and conditions in schools often cause a variation of this program.

The work of the hygienist consists of the cleaning of the children's teeth, after which an examination of the mouth is made to ascertain whether fillings or extractions are necessary, or any abnormal conditions of the mouth exist. If other dental work is necessary, notice is sent to the parents. Families that are able to pay for the services of a regular dentist are urged to have the work done at once. If they are unable to employ a regular dentist, a card is given to the child to report to the dental dispensary. The hygienist also makes note of any dental treatment that a child may need, and a check-up is made on the next visit of the hygienists' squad to the school. During the year 1925, 104,077 prophylactic operations were performed in the various schools and institutions. In 1925, fifty-one public schools, twenty-nine parochial schools, one high school, four junior high schools, two shop schools and two continuation schools were visited; also seven orphanages. The work of the regular hygienists has not been confined to the City of Rochester. At various times during the year, squads of hygienists, with the necessary equipment from the dispensary, gave several thousand prophylactic treatments to school children in some of the smaller towns just outside Rochester.

There has been most cordial cooperation on the part of the mayor and city officials, the health officer and bureau of health, the board of education, superintendent, principals and teachers in the public schools, and the bishop, priests, sisters superior and teachers in the parochial schools. The superintendents of the various orphanages have also cooperated to the fullest extent.

The benefits of the work are noticeable and have received the cordial commendation and approval of those who have been in a position to observe the striking improvement in the health and appearance of the children. There is no other city in the world where dental service of this nature has been made available or where there has been an

effort made by public authorities to coordinate the mouth hygiene work in the schools with that of a dispensary for doing general dental work. Rochester occupies a unique position with reference to this work.

THE DENTAL HYGIENIST

Soon after the prophylactic work was started in the Rochester schools, it became evident that if proper service was to be rendered, some assistance other than that from dental graduates must be provided. On account of the raising of the entrance requirements in dental schools, the number of graduates was much reduced. Coupled with the number required for dental offices and the wastage from other causes, few dental graduates were available for public service activities. It, therefore, became necessary to establish a school to train young women to do this work. The dental hygienist school in connection with the dispensary was organized nearly ten years ago. At that time, it was regarded in the light of an experiment, and many doubts were expressed about the wisdom of creating a new vocation for women. I am well aware that even today much doubt and prejudice exists in many parts of the country with reference to the value of and desirability of employing dental hygienists. However, I am glad to say, that, after practically ten years of experience with us, the dental hygienist has demonstrated her usefulness and rendered service of a very high order. Not only is she necessary to the proper rendering of prophylactic service, but she also has a distinct place as a health teacher in the schools and in the instruction of parents and children in matters of hygiene, nutrition and many other things.

I regard the dental hygienist as occupying the same relative position to the dentist that the medical nurse does to the physician—just as important and just as valuable. Without the slightest desire to seem to force my personal opinion on anyone, I say here that, in my deliberate judgment, no proper dental health program can be successfully carried on without the assistance of properly educated and trained dental hygienists.

LECTURE WORK

A valuable adjunct to the prophylactic work has been the preparation of the minds of the pupils to appreciate its value and benefits by illustrated lantern slide lectures and talks, which have been given by a lecturer from the dispensary. The efficient health officer of the City of Rochester, Dr. George W. Goler, has complimented us by saying that, by our lecture and other work, we were the first agency in the city to teach personal hygiene. From the advice given with reference to the value of the toothbrush in keeping the mouth clean, there has sprung up a desire on the part of the child to wash other parts of the head, face and body, and the leaven has also spread to older members of the family. We are teaching the children that the apelike habit of sticking their dirty fingers into their mouths is fraught with much danger. Another very noticeable result of the lecture work may be observed in the abolition in some, and a considerable reduction in other families, of the family toothbrush, well known as a disease carrier.

ADULT CLINIC

While an adult clinic was not contemplated at the time of the establishment of the dispensary, considerable dental work of various kinds has been done for students of the University of

Rochester, the Eastman School of Music, the Women's College connected with the University, the Theological Seminary and some other institutions. This service has been rendered for the most part to those who are working their way through college and are not able to pay a regular dentist. The other purpose in giving this service is to provide a wider field of clinical service for the interns.

COMPENSATION OF THE PROFESSIONAL STAFF

There is no free service in the dispensary, either in the dental department or the hospital. Every medical and dental operator or assistant employed is paid a stipulated salary. It has been our experience that volunteer or free service in public institutions, except in rare cases, is neither dependable nor reliable, and I regret to say that this applies also, in a large measure, to part time service.

Since the opening of the Rochester Dental Dispensary, more than 60,000 children have received treatment of one kind or another. Time will not permit me to go into further detail with reference to our activities, and the many interesting things that have been observed. While from the beginning the controlling thought in our various endeavors has been prevention, in order to carry this idea on considerable work of a reparative nature was necessary to gain the sympathy and cooperation of various agencies. I am quite sure you will not be surprised when I tell you that many difficulties were encountered and many obstacles had to be surmounted during the formative period of our work. Naturally, there was opposition from various sources, due in most part to prejudice and a lack of understanding of our purpose. It is a real pleasure to tell you that, at the present time, a fine spirit of cooperation and genuine helpfulness prevails.

While the name of our institution indicates that it was established for dental purposes only, that has not been the case. In our many activities, it has been our constant purpose to think in terms of the effect of our work on general health, rather than of teeth. We realize that it will be many years when, and perhaps never that, rescue, repair and relief work will not be required, but that should not deter us from continuing our efforts in experimentation and the research field. We are fully aware that repair work on adults is of little real value, except the contribution to the comfort of the individuals. The hope of the future depends on the progress we may make in the education of the prospective mothers, and of the child. The value of proper nutrition, hygiene and sanitation must be stressed; likewise, the need for prompt attention to the correction of physical defects. Our own native American people may draw a wholesome lesson from the readiness and promptness with which the foreign born respond to and cooperate in general health activities. This may be due in some measure to a greater appreciation of the economic value of good health, on the part of the foreign born, or those of foreign parentage. It was interesting to note in the tonsil survey made some years ago that the percentage of operable cases was larger in children from the so-called better neighborhoods, where there were no foreign born, than from the distinctly foreign or poorer sections. This may to some extent be accounted for by the educational work done by the various health agencies in teaching the foreign

born more correct ways of living, especially in sanitation.

If I read your thoughts correctly, I am inclined to the belief that you want some tangible evidence of the benefits and value of our activities. We have endeavored to keep accurate records, not only of the professional side of our work, but also of the business side, and we are always glad to give anyone interested free access to all of our books and records. It will be a pleasure at any time to give anyone interested in the financial or professional parts of our work any detailed information which might be helpful to them. Either because of a lack of vision or of the ability to understand, or perhaps for other reasons, I have not been greatly interested in excessively detailed or involved professional and other kinds of statistics. In many instances, I have observed a tremendous waste of time, energy and money in the preparation of split up statistics, understandable in most cases only to the one who is trying to demonstrate his importance or prove his own case. Largely for that reason, a very simple survey card was adopted when our work started. A complete survey of the mouths of all the school children was made, and it was discovered that approximately 95 per cent of the children had dental defects. We had planned to make a resurvey at the end of five years, but on account of the great expense, it was decided to make the survey in typical schools and corresponding grades. Our findings were exceedingly gratifying, and dental defects were reduced from 95 to 73 per cent. A recent survey, four years after, by health bureau officals, in a typical school, brings the dental defects down to 67 per cent, about 50 per cent of which require tooth extracting only.

In a comparison of the condition of the first permanent molars between the time of the first survey and five years after, we found a gain of nearly 100 per cent in teeth charted as good, a 50 per cent gain in those listed as decayed. General mouth conditions during that period improved about 50 per cent, and the number who were registered as having received dental treatment increased 200 per cent, owing, of course, in a large measure, to the facilities provided for dental work, and credit should also be given to the educational work done by lecturers and dental hygienists.

You will be interested to know that much of the dread of dental operations on the part of children has been removed by careful treatment and kindly attention, and this applies equally to patients in the nose and throat department. Unbelievable as it may seem to some of you, we really have a very happy family. I regard as probably the best evidence of satisfaction with our work, the general approval and commendation observed from the speech of those who are familiar with our activities, the mayor and city officials, the board of aldermen, the superintendent of schools, board of education, principals and teachers, both in public and parochial schools, the health officer and school doctors and nurses, and all the various health and child welfare agencies in Rochester. Last and most important of those whose testimony should be convincing as to the benefits and value of the work is George Eastman, the founder and generous benefactor, who loses no opportunity to express his delight and satisfaction with the work that is being done by the Dental Dispensary to improve the condition of the children of Rochester.

Throughout all of the activities of

the Rochester Dental Dispensary from its very beginning, there has been no attempt on the part of anyone to do anything that was fantastic or spectacular. There has been no hesitation in adopting new methods whenever they appeared to be an improvement on well recognized operative procedure. Neither have we hesitated about following the plans that have appeared satisfactory in other clinics. It would give me great pleasure to make formal acknowledgement of our indebtedness to all who have contributed to the success of this enterprise, but the sources of help and inspiration have been so many and varied that it would be quite impossible to mention or enumerate them. Mr. Eastman, the board of trustees and the professional staff of the Rochester Dental Dispensary appreciate to the very fullest extent the invaluable assistance that has been rendered by its many friends.

REPORT OF DISPENSARY AND SCHOOL ACTIVITIES

—1925—

Tooth treatments	4,306
Root treatments	4,215
Gum treatments	2,304
Silver nitrate treatments	14,072
Orthodontia treatments	8,544
Prophylactic treatments	728
Abscess treatments	229
Root fillings	1,196
Amalgam fillings	26,609
Cement fillings	23,344
Synthetic fillings	754
Guttapercha fillings	1,177
Roentgen rays	6,161
Extractions	17,174
Extractions procain	2,952
Inlays	296
Pulps devitalized	1,030
Pulp pressure	96
Pulps capped	689
Crowns	46
Plates	15
Bridge	17
Dismissals	10,342
Number of visits to Dispensary	68,105
Number of patients that paid	56,763
Lectured to in the schools	15,790
Prophylactic treatments in schools	104,077
Orthodontia cases under treatment	298

Surgical Department

Tonsil-adenoid operations	1,682
Number of visits to Dispensary from October 15, 1917 to January 1, 1926	477,820
Total tonsil-adenoid operations to January 1, 1926	10,290

DISBURSEMENTS—1925

Dental	$ 38,749.78
Extracting	3,462.32
Orthodontia	11,839.82
Roentgen ray	217.99

Surgical	13,767.93
Clinics and lectures	592.00
Library	31.00
Office	1,431.10
Building	517.22
Repairs and alterations	1,342.92
General	35,760.26
Real estate	6,937.50
	$114,649.84
School Account	
Hygienists and schools, salaries and supplies	33,618.07
	$148,267.91

BUDGET—1926

	Estimated 1925	Expended 1925	Estimated 1926
Dental	$ 38,000.00	$ 38,749.78	$ 40,000.00
Extracting	3,500.00	3,462.32	3,500.00
Orthodontia	14,000.00	11,839.82	14,000.00
Roentgen ray	500.00	217.99	500.00
Surgical	13,000.00	13,767.93	14,000.00
Clinics and lectures	500.00	592.00	700.00
Library	100.00	31.00	100.00
Office	1,000.00	1,431.10	1,500.00
Building, repairs and alterations	2,000.00	1,860.14	3,000.00
General	40,000.00	35,760.26	40,000.00
Kenilworth Terrace	500.00	6,937.50	
	$113,100.00	$114,649.84	$117,300.00

THE DENTAL HEALTH PROBLEM AND THE FORSYTH SOLUTION—CHILDREN'S DENTISTRY*

By FRANK A. DELABARRE, A.B., D.D.S., M.D., Boston, Massachusetts

DENTISTRY had its beginnings as a mechanical trade. The advent of the dental school made it a profession, and the constantly expanding curriculum has gradually introduced the broader scientific attitude; but the profession is still dominated by the mechanical influence, and its work even now is still curative and reparative in character. Its growth and progress have been remarkable, but it has made no progress in controlling the occurrence of disease. With our present knowledge, it is time to turn our attention to prevention.

The individual work of Fones, Jordan, Wilson, Thomas, Sutton, and others, the investigations of Hyatt and of Bodecker, and the experience of public clinics, handling children in large

*Abstract of a correlated symposium presented by the Dental Hygiene Council of Massachusetts at the convention of the State Dental Society, May 6, 1926.

numbers, notably the Forsyth, prove beyond a doubt that a large measure of prevention is within our grasp. The figures of the Forsyth Infirmary show conclusively that, by early attention and a periodic and systematic follow-up, the extraction of first permanent molars has been reduced from 33 per cent down to one-half of 1 per cent and approximately 80 per cent of decay has been eliminated.

This is convincing proof. There is and can be no argument against prevention of disease if it can be practically accomplished. It is our duty to see that the principles and practice of prevention are made available for the public from now on, not only in clinics, but also in private practice. They will welcome it. The place to begin is in the dental school curriculum, and it is encouraging to note that thirteen of our forty-three schools now have courses in children's dentistry.

All public clinics must follow the lead of the Forsyth clinic and adopt its methods. The difficulty of applying the same idea to private practice is centered mainly around two questions: The management of children, and the compensation.

Let it be stated that no practitioner need work for children if, for any adequate reason, he does not wish to, but he is still under moral and professional obligation to acquaint the parents with these latest findings, and refer the child to some one equipped by education and personal qualifications to do the needed work.

The dentist in general practice, who wants to give the child adequate attention can begin with one family, or set aside one afternoon a week for such work, and extend the service gradually. The man who intends to specialize must have the essential qualifications of love for children and the experiences acquired in public clinics to qualify him for it. The assertion is made by competent authorities that children properly approached, handled and educated make better patients than adults. Gaining their confidence is the key to success.

As to the fee, it is logical and proper to make a charge commensurate with the benefit given. This type of dentistry is a service, not a series of operations; a service necessitating the expenditure of time in educating the patient as to the advantages to be gained and the necessity of cooperative home hygiene; a service that must be continuous during childhood; a service that can deliver the maximum of prevention with the minimum of operative work. Its results are seen in the freedom from pain, the maintenance of function and the preservation of health, local and general.

In view of the character of the service and the end-results, the fee should be put on the yearly basis. Statistics show that from two to three hours per year are sufficient for children that start early with a mouth in good condition. Compute your own fee per year according to the case and your ability.

This whole idea is endorsed by the state department of health, by the division of hygiene of the Boston Public School Committee, and by representatives of the medical profession, as well as by a large number of progressive, thinking men of our own profession.

The resolutions presented for adoption follow:

RESOLUTIONS ADOPTED BY THE MASSACHUSETTS DENTAL HYGIENE COUNCIL

WHEREAS, Up to the present, the attention of dentistry has been centered mainly on the work of restoring lost dental tissue, and

WHEREAS, The only hope of real progress lies in the prevention or early control of dental disease, and

WHEREAS, Prevention, to be effective, must be applied early in the life of the individual—and early in the life of the tooth; be it

Resolved, That dental service must begin early, and be systematic and periodic in order to obtain the maximum of prevention with the minimum of operative work, and to properly educate the child in habits of oral hygiene; and be it

Resolved, That in the aim to attain prevention of systemic and dental disease

(*a*) No defect is too slight to receive definite attention.

(*b*) The temporary teeth should receive as much care as the permanent ones in order to promote the proper development of the jaws and head, and to maintain function.

(*c*) Particular care and attention should be given to developmental pits and fissures, whether occurring in primary or secondary teeth, or whether decay is or is not present; and be it

Resolved, That the Dental Hygiene Council of Massachusetts declares for the principles and practice of children's dentistry, and maintains that the most effective dentistry that can be done for any individual is the service rendered between the second and fourteenth years of age, and be it

Resolved, That this Council calls upon all dentists to uphold these fundamental principles, and to do everything possible to promote the practice of children's dentistry by professional and public education, and in public and private practice.

March 29, 1926.

FIELD ACTIVITIES OF THE DEPARTMENT OF DENTAL HEALTH EDUCATION

Spring is the time of conventions, offering an opportunity for visiting different states, seeing the work carried on first-hand, and exchanging ideas and pooling experiences. Attendance at different conventions means that the Department of Dental Health Education will better understand the dental health educational work in the country and so become a more efficient clearing house and information center. This spring, the director of the Department was invited to the Michigan State Dental Society meeting held at Detroit, the Iowa meeting at Des Moines, a meeting of the Western Pennsylvania Odontological Society in Pittsburgh, the Nebraska meeting at Lincoln, the Missouri meeting at St. Louis and the National Health Congress at Atlantic City. The first two meetings were attended.

THE MICHIGAN MEETING

Dental health work in Michigan should be closely watched by every state. A new department of the state department of health—the bureau of oral hygiene and preventive dentistry—has recently been established, and Dr. William R. Davis has been appointed director. Dr. Chalmers J. Lyons, of the University of Michigan, is a member of the state board of health, and there is an active committee on mouth hygiene and public instruction in the state dental society. All of these groups are working together, so that a program representative of the dental profession and administratively sound from a public health point of view is being developed.

THE IOWA MEETING

Iowa is carrying on an outstanding piece of dental health work. It is the only state to support a full-time worker from Sheppard-Towner funds. Dr. G. H. Wandel, of Iowa City, is in charge of the program which is being developed under the state board of education, working through the university extension service. Dr. Wandel and Miss Ethel Reuben, a dental hygienist, cover the state, holding dental educational clinics for preschool children and expectant mothers. They also examine the children in the lower grades and lecture to school children and civic clubs.

At the state meeting, there was a section on preventive dentistry. The program was arranged by the committee on mouth hygiene and public instruction of the state dental society, of which Dr. J. G. Hildebrand, of Waterloo, is chairman, Dr. G. H. Wandel and Dr. C. L. Drain of Iowa City, being the other members. An innovation was introduced which proved to be very successful. Realizing that much of the dental health educational work and examining of school children must be carried on by the educational and public

health agents already in the field, and feeling that the public health and school nurses are the most logical persons to do this, the state dental society invited all of the public health nurses in Iowa to attend the state meeting. Lectures on various phases of dental health were given and the nurses received instruction in mouth examinations. Several dental hygienists in public health work demonstrated to the nurses how to examine and chart mouths, and the members of the committee answered innumerable questions that came to the minds of the nurses. There were about 100 present.

There is a question whether it might not be feasible for other states to follow this unique plan developed by Iowa, for, undoubtedly, the public health nurses and the school teachers will have to help in the solution of the dental problem.

DENTAL SLOGANS

A set of thirty dental slogans, 15″x10″, may be purchased for 10c each; 50c for any 10 or $1.00 a set. Please order by number. Following are the slogans:

1. Teeth are built from the foods you eat. Milk and the dairy products, fruits and vegetables, and whole grain bread are most important.
2. End your meal with a self-cleansing food: celery, lettuce, apples, etc.
3. Chew your food well; your stomach has no teeth.
4. Spare the sweets and save the teeth.
5. First teeth are the pathfinders of permanent teeth. Guard them well.
6. Coarse fool well chewed saves teeth and preserves good health.
7. Be both "choosey" and "chewsy" about eating.
8. Choose your food wisely and chew your food well.
9. Be true to your teeth or they will be false to you.
10. There are thirty-two reasons why every member of every family should have a toothbrush; every reason is a tooth.
11. A toothbrush is a better friend than a toothache.
12. A clean, healthy mouth is good life insurance.
13. Brush your teeth after meals. Use a down stroke on the upper teeth. Stroke up on the lowers—jaws apart.
14. Dirty teeth decay most at night.
15. A dirty mouth poisons the whole system.
16. Fill your candy box with fruit.
17. Whose teeth will you be wearing when you are 40?
18. Have you a perfect 32?
19. Many people are digging their graves with their teeth.
20. See your mouth as others see it.
21. An unhealthy mouth neglected never gets better.
22. Keep well teeth well.
23. Make your dentists' office a service station, not a repair shop.
24. Be selfish about your toothbrush. It is yours only.
25. The best toothpaste or toothpowder is elbow grease.
26. A tooth in the mouth is worth ten on a plate.
27. An ounce of prevention is worth a pound of promises.
28. It is easier to prevent tooth decay than to check it.
29. If a tooth could talk, it would surely say, "I need to be brushed three times a day."
30. When you come to the end of a perfect day, clean your teeth.

FIELD NOTES*

The Ohio State Department of Health has distributed throughout the state about 16,000 copies of the bulletins of the American Academy of Periodontology. Any state department of health can obtain permission to print these bulletins by applying to the Department of Dental Health Education of the American Dental Association.

Smithfield, Utah, is conducting a dental health campaign in the schools, with 100 per cent corrections as the goal. During "Health Week," one day has been set aside for the schools in order that they may demonstrate what has been done along health lines.

The Bureau of Maternal and Child Health of the State Board of Health of Kentucky is distributing the pamphlet "Children's Teeth—How to Use and Keep Them" (Part II), which is published by the Department of Dental Health Education, American Dental Association.

*The Department of Dental Health Education will be glad to receive items of news along the lines of education in dental or general health.

Medical and Dental News

Florida

Medical Arts Building: The Medical Arts Building Company, Tampa, announces that it will erect a twelve story office building at the corner of Plant and Grand Central avenues, at a cost of about $1,200,000, which will be devoted exclusively to the use of physicians and dentists. The project, which is said to have been approved by the Hillsborough County Medical Society, has been financed and the site purchased, and nearly all the space in the building leased. The structure has been planned to provide the utmost convenience to the two professions.—*J.A.M.A.*, May 8, 1926.

Illinois

Health Examinations: At the Midwinter Clinic of the Chicago Dental Society, health examinations were available to those interested, and fifty-four dentists were examined, forty-seven being given a thorough examination. Nine presented conditions demanding immediate attention: (1) positive Wassermann reaction; (2) overweight, tachycardia, frequent urination, with trace of sugar; (3) loss of weight, bronchial breathing and rales, and enlarged liver; (4) muscular atrophy of legs, and absence of Achilles reflexes; (5) overweight, slight elevation of blood pressure, palpable liver, and trace of albumin in urine; (6) increased blood pressure, questionable condition in the lower abdomen; (7) tachycardia, increased blood pressure, trace of albumin in urine; (8) increased blood pressure, 6.6 per cent sugar in urine; (9) overweight and suspicious Babinski reflex. Of the weight variations from average, eight were materially increased and five decreased. Twenty-one out of the forty-eight were not in the habit of having periodic dental examinations. Eleven had a noteworthy tachycardia. Seven had noteworthy blood pressure changes, four high and three low. Seven had flat feet and nine well marked or incipient hernias. Of thirty-two Wassermann tests, only one was positive. Of forty-nine specimens of urine, one had sugar in abundance, two had traces of sugar and five had traces of albumin. No one was without distinct defects, and in only eight cases were the defects minor. Of the twenty-four mouths examined, only five were in reasonably good condition, the remainder being in need of immediate care. The ages varied from 26 to 62, and although the more hazardous conditions were found in the period between 40 and 62, no decade was without some serious defects. The examinations were under the supervision of Dr. James Hutton.

Resolution Regarding Anesthetics: The Rock Island County Medical Society, Moline, passed a resolution, May 11, reiterating, among other things, that the giving of anesthetics is the practice of medicine, and resolving that it shall be unethical for any member of that county society to employ any one but licensed and qualified physicians to administer anesthetics except under supervision in emergency.—*J.A.M.A.*, May 22, 1926.

Illinois State Society Meets: The sixty-second annual meeting of the Illinois State Dental Society was held in Springfield, May 11-13, at the Elks' Club. Among the essayists were A. E. Webster, Toronto, Canada, Louis Schultz, Chicago, Edgar D. Coolidge, Chicago, G. Arthur Nelson, Rock Island, Herbert E. Phillips, Chicago, John G. Hildebrand, Des Moines, G. Walter Dittmar, Chicago Senator Richard J. Barr, Joliet, W. I. McNeil, Chicago, and F. M. Hight, Houston, Texas.

Physical Examinations of Dentists: Seventy-nine dentists submitted to the physical examination offered by a corps of twelve physicians as a feature of the Illinois State Dental Society meeting, May 11-13. According to

the *Bulletin of the Chicago Dental Society*, reports of results are not yet complete, but enough data are already recorded to indicate that it is high time that dentists begin to practice what they preach about regular physical check-ups. Not only did the group, as a whole, show a comparatively high percentage of conditions needing a physician's attention, but among the seventy-nine were several who evidently have been too busy caring for others' teeth to have their own dental work done.

Conviction of Illegal Practitioners: The Chicago Dental Society reports through its *Bulletin* 100 per cent convictions in its campaign against illegal practitioners. Dr. E. Byron Kelly was appointed counsel for the state society to assist in making the clean-up state-wide.

Dr. Schultz Presents Cases Before Medical Society: At the May 26 meeting of the Chicago Medical Society, Louis Schultz, of Chicago, reported the case of the removal of a large root cyst, with an involved molar *en masse;* and, with R. C. Willett, Peoria, Ill., a case of reconstruction of a lower jaw, with bilateral resection.

Health Studies: The Elizabeth McCormick Memorial Fund is printing a report of the results of an intensive research into the health status of more than 1,000 school children of the elementary schools of Oak Park, conducted by means of physical examinations, measurements of physical growth, dental examinations, and observation of progress through grades. The fund is also conducting studies of the physical and mental growth of children and developing methods of promoting health in some of the public schools of Joliet and Chicago.

Chicago Dental Society Meets: At the regular monthly meeting of the Chicago Dental Society, May 18, Newton G. Thomas read a paper on "The History and Present Status of Research in Periodontitis" and Kaethe W. Dewey read a paper on "Tissue Changes and Regeneration Potencies in Periodontitis."

Indiana

Indiana State Association Meets: The sixty-eighth annual meeting of the Indiana State Dental Association was held in Indianapolis, May 17-20, 1926. In addition to a comprehensive program of clinics, lectures were given by Dayton Dunbar Campbell of Kansas City, W. N. Wishard (M.D.), Indianapolis, J. R. Blayney, Chicago, A. Alfred Nelson, Detroit, F. B. Rhobotham, Chicago, Willis A. Coston, Kansas City, K. W. Knapp, St. Paul, and Edward L. Miloslavich, Milwaukee.

Iowa

Iowa State Dental Society Meets: The sixty-fourth annual meeting of the Iowa State Dental Society was held in Des Moines, May 4-6, at the Hotel Savery. J. G. Hildebrand, of Waterloo, A. D. Black and C. N. Johnson, Chicago, spoke at the general sessions. Essayists appearing on the section programs were Polk E. Akers, Chicago, E. T. Tinker, Minneapolis, Amy Daniels, Iowa City, John G. Hildebrand, Waterloo, C. L. Drain, Iowa City, Evelyn C. Schmidt, Chicago, J. T. Martin, Muscatine, R. A. Fenton, Iowa City, E. L. Moravec, Cedar Rapids, L. M. FitzGerald, Dubuque, W. A. Lanphere, Des Moines, J. W. Marion, Des Moines, Emma Feichtinger, Sioux City, C. E. Woodbury, Council Bluffs, and W. J. Charters, Des Moines. An elaborate program of clinics was also given.

Dr. DeFords Honored: Graduates of the Dental Department of Drake University during the deanship of Dr. W. H. DeFords, gave a dinner in his honor, May 4.

Kentucky

Green River Society Meets: The Green River Dental Society held its regular monthly meeting, May 13, at Owensboro. After a banquet, J. T. O'Rourke, acting dean of the Dental Department of the University of Louisville, spoke on "Radiographic Interpretation of Bone Changes."

Minnesota

Southern Minnesota Dental Association Meets: The Southern Minnesota Dental Association met, June 14-15, at Fairmount, for the annual convention, with an attendance of more than 200. The entire program, including clinics, motion pictures, essays and health and manufacturers' exhibits, was housed under one roof, in the American Legion Building. On the program were William A. Grey, St. Paul; K. W. Knapp, Minneapolis; R. G. Keyworth, St. Paul; C. H. Jamison, Frederic, Wis.; F. E. Anderson, Red Wing; E. C. Rosenow, Rochester, and H. B. Clark, St. Paul.

Missouri

Missouri State Association Meets: The annual meeting of the Missouri State Dental Association was held in Jefferson City, May

17-19. The meeting was given over largely to clinics, a very comprehensive program being presented. Among the essayists were W. J. Brady and John W. Needles, Kansas City; O. W. Brandhorst, Clarence O. Simpson, James M. Gray, George B. Winter and Elbert B. Owen, St. Louis. W. A. Sutton of Atlanta, Ga., addressed the general meeting.

NEW YORK

Study of Malnutrition: The New York Children's Aid Society has recently completed and made public the results of a five years' study of malnutrition among school children. The society conducts ten health-center schools which are attended by handicapped children, and these schools have within the past five years brought back to health more than 8,000 handicapped children. This health-building work has reduced undernourishment from 41 per cent to 16 per cent among the children in these schools.—*M. J. and Record.*

OHIO

Cleveland Dental Society Meets: The Cleveland Dental Society met, May 3, in the Hotel Winton, for their annual session and election of officers. The essayist of the evening was R. W. Bunting of Ann Arbor, Mich., who spoke on "The Etiology and Treatment of Pyorrhea."

TENNESSEE

State Association Meets: The Tennessee State Dental Association met, May 4-7, in their fifty-ninth annual session, at Nashville. Taking part in the program of lectures and clinics were R. R. Gillis, of Hammond, Ind.; R. E. Blackwell, Chicago, Ill.; Jesse D. White, St. Louis, Mo.; Olin Kirkland, Montgomery, Ala.; H. S. Mustard (M.D.), Murfreesboro, Tenn.; W. D. Haggard (M.D.), Nashville, Tenn.

VIRGINIA

Joint Meeting of U. S. Unit and Virginia Association: The Virginia Tidewater Dental Association and the Dental Unit U. S. Naval Hospital met in joint session, Tuesday, May 4, at the U. S. Naval Hospital, Norfolk. Among the essayists were W. L. Darnall, Washington, D. C.; Adolph Berger, New York City, Sterling V. Mead, Washington, D. C.; Edward C. Kirk, Philadelphia, Pa., and Carlton N. Russell, Philadelphia, Pa. A program of essays was presented in the Red Cross Building, as were table and chair clinics. General surgical clinics, including nose and throat clinics, were held in the main building and the bacteriologic clinic was held in the Bacteriological Laboratory Building. The late afternoon was given over to recreation drills and a base ball game on the Parade Ground, after which dinner was served in the Mess Hall, Main Building.

WISCONSIN

Results of Clean-Tooth Campaign: According to *Hygeia*, the clean tooth campaign has "worked wonders." Ninety-seven per cent of the families in Milwaukee use some form of preparation, over 90 per cent preferring tooth paste. There are eighty-three brands of tooth paste. The average drug store carries seventeen brands, and two or three brands net 80 per cent of the business. Only 7 per cent of the population use tooth powder. There are thirty-nine different brands of mouth washes, and about 12 per cent of the people use them.

GENERAL

Drs. Logan and Barrett Honored: At the close of the current school year, W. H. G. Logan, of Chicago, and Thomas J. Barrett, Worcester, Mass., were the recipients of the honorary degree of doctor of law, conferred by the Chicago College of Dental Surgery of Loyola University.

Government Representatives to Congress Appointed: The following have been commissioned by the President of the United States to act as delegates to represent the United States at the Seventh International Dental Congress, at Philadelphia, Pa., Aug. 23-28, 1926: The Hon. Henrik Shipstead, U. S. Senator; Lieut. Com. W. L. Darnall, U. S. N., of the Navy Dental School; the Hon. Roy O. Woodruff, U. S. Representative; and the officers of the Seventh International Dental Congress: William H. G. Logan, president; Otto U. King, secretary-general; Henry L. Banzhaf, treasurer; H. E. Friesell and William A. Giffen, vice presidents; and Sheppard W. Foster, honorary vice president.

College Health Examinations: Health examinations on entrance into college or university are becoming the rule rather than the exception. In the majority of institutions, the examination is given after the student has matriculated. Sixty-eight of 152 institutions require the examination before the student is admitted. Of these, fifty-two require that the examination be performed by a college physician; and the remainder, that the student possess a certificate of health from his family physician.—*J.A.M.A.*, April 17, 1926.

Residual Expenditures: Important in fact, but not very large in amount, is the expenditure for the maintenance of health. Statistics of family budgets show that, in the $2,100 to $2,500 income class, this item totals about $80 per annum per family. This expenditure is divided as follows:

Physician, surgeon, oculist	$37.50
Medicine	11.30
Nurse	3.00
Hospital	8.00
Dentist	15.00
Eyeglasses	3.40
Total	$78.20

Prize Awarded Harvey Cushing: Among the list of awards of the Pulitzer Prizes for this year is one of one thousand dollars to Prof. Harvey Cushing, surgeon in chief of the Peter Bent Brigham Hospital and professor of surgery in the Harvard Medical School, for his "Life of Sir William Osler." The judges selected this work as the best American biography of the time.

Army Dental Corps

Maj. Lester C. Ogg from duties at Ohio State University, Columbus, June 15 to Fort Benjamin Harrison, Ind., for duty.

Capt. Roy L. Bodine from station at Fort Leavenworth, Kans., June 15 to Washington, Walter Reed General Hospital, for duty.

Capt. Leroy P. Hartley from duty at Fort Benjamin Harrison, Ind., June 1 to Fort Leavenworth, Kans., for duty.

Capt. Willam J. Adlington from duty at Fort Huachuca, Ariz., May 15, to Fort Monmouth, N. J., for duty.

Capt. John A. Rowe from duty at Fort Monmouth, N. J., June 15, to Fort Huachuca, Ariz., for duty.—*Army and Navy Register*, May 1.

Maj. Earle J. McClung, from duties at Camp Lewis, Wash., about May 15 and then detailed at North Pacific College of Oregon, School of Dentistry, Portland, Oregon.

Maj. Walter L. Reesman, from duties at North Pacific College of Oregon, School of Dentistry, Portland, Oregon, about June 15, to Camp Lewis, Wash., for duty.

Capt. Walter D. Love, from Military Academy, West Point, N. Y.; to New York city and about July 28 via Government transportation to Army Forces in China for duty.

Maj. John L. Schock, from duty at Presidio of San Francisco, via transport to leave San Francisco for New York city about August 14; to Walter Reed General Hospital, Washington, for duty.

Maj. George R. Tressel, from duties at Fort Wayne, Mich., and detailed at St. Louis University School of Medicine, St. Louis, Mo.

Capt. E. Frank Sharp, to duty at Camp Marfa, Texas, upon completion of services with Army Forces in China.—*Army and Navy Register*, May 8.

Capt. John S. Ross from duty in Hawaii to duty at Presidio of Monterey, Calif.

Capt. Clarence C. Olson from duty in Hawaii to duty at Fort McDowell, Calif.—*Army and Navy Register*, May 15.

Deaths

Garman, Jared M., Chicago, Ill.: Northwestern University Dental School, 1923; died, March 2, of heart failure, superinduced by dropsy; aged 60.

Lord, William H., Chicago, Ill.; Chicago College of Dental Surgery, 1903; died recently.

Lyon, George H., Chicago, Ill.; died, April 18, 1926.

Raubolt, W. F., Chicago, Ill.; Chicago College of Dental Surgery, 1904; died, May 16, of heart trouble; aged 44.

The Medical and Dental Arts Building, to be erected at the corner of Wabash Avenue and Lake Street, Chicago.

AMERICAN DENTAL ASSOCIATION SIXTY-EIGHTH ANNUAL SESSION

PHILADELPHIA, PA., AUG. 21-27, 1926

OFFICIAL CALL

To the Officers, Members and Constituent Societies of the American Dental Association:

You are hereby notified that the Sixty-Eighth Annual Session of the American Dental Association will be held at Philadelphia, Pa., Aug. 21 to 27, 1926.

The House of Delegates will convene at 10 o'clock in the forenoon and 2 o'clock in the afternoon, Saturday, Aug. 21, 1926, in the Bellevue-Stratford Hotel, Philadelphia, Pa.

The third and fourth meetings of the House of Delegates will be held in the same hotel, Monday, Aug. 23, 1926, at 3 p. m., and Tuesday, Aug. 24, 1926, at 3 p. m.

The Registration Department will be open from 9 a. m. until 5 p. m., Saturday, Aug. 21, 1926, and from 3 to 4 p. m., Monday, Aug. 23, 1926, and Tuesday, Aug. 24, 1926, at the Bellevue-Stratford Hotel, Philadelphia, Pa.

The Constituent Societies are hereby notified to file with the General Secretary of this Association, at his office, 58 E. Washington St., Chicago, Ill., at least thirty (30) days prior to the first day of said Annual Session, a list of the names and addresses of their delegates and alternates to said House of Delegates.

The general meeting of the American Dental Association, the meetings of the various sections and the clinics, will be merged in those of the Seventh International Dental Congress, to be held at Philadelphia, Pa., beginning Aug. 23, 1926, at 10 a. m., and continuing through Aug. 27, 1926.

SHEPPARD W. FOSTER, *President.*
OTTO U. KING, *General Secretary.*

SPECIAL ANNOUNCEMENT

To the Officers, Members, Constituent Societies and Delegates to the Sixty-Eighth Annual Session of the American Dental Association:

Special notice is hereby given, in connection with the foregoing regular notice of the Annual Session, that the following amendments to the Constitutional and Administrative By-Laws of the American Dental Association were proposed at the Annual Session of 1925, at Louisville, Ky., and were then laid on the table until the Annual Session of 1926, which is to be held at Philadelphia, Pa., Aug. 21-27, 1926.

The proposed amendments are as follows:

TRANSFER OF MEMBERSHIP

WHEREAS, no provision is made in the Administrative By-Laws of the American Dental Association for the transfer of membership from one constituent society to another, and

WHEREAS, the American Medical Association has a provision for the transfer of members of the American Medical Association from one constituent society to another; be it therefore

Resolved, that Chapter 1 of the Administrative By-Laws be amended by adding the following section to be known as Section 9. "A member of the American Dental Association who changes the location at which he practices dentistry from the state through whose constituent society he holds membership in the American Dental Association to another state in which there is a constituent society is eligible to membership in the constituent society of his new location on the presentation of a transfer card and an official

statement that his dues have been paid in full in the society in which he holds membership; provided that no evidence which would otherwise disqualify him arises. Furthermore, if the Constituent Society in whose territory such member has moved should refuse him membership, the member shall be privileged to appeal to the Judicial Council of this Association to determine whether or not he is guilty of any act that warrants the enforcement of the provisions of this section. Pending the decision of such appeal, he shall retain his membership in the American Dental Association through his original state association.

ELECTION OF SPEAKER AND VICE SPEAKER

WHEREAS, for a number of years the duties of the President have become increasingly difficult, owing to the fact that he is called on to preside at the meetings of the House of Delegates and he is thereby prevented from attending scientific sections of the society, and

WHEREAS, the interests of the American Dental Association make it imperative for the President to devote a large amount of his time to the study, supervision and examination of the scientific sections and

WHEREAS, the American Medical Association has improved the efficiency of the organization by employing a speaker to preside over the House of Delegates, be it therefore

Resolved, that Article IX, Section 1, of the Constitutional By-Laws be amended to read as follows: "The General Officers of the Association shall be a President, a President Elect, three Vice Presidents, a General Secretary, and a Treasurer, and a Speaker and a Vice Speaker of the House of Delegates."

ADDRESS AND REPORT OF PRESIDENT

WHEREAS, a constitutional amendment has been proposed having for its object the creation of a speaker of the House of Delegates and

WHEREAS, such an office, if created, will modify the duties of the President, be it therefore

Resolved, that if the office of "speaker" is created by the proposed change of Article IX, Section 1, of the Constitutional By-Laws, Chapter VIII, Section 1, of the Administrative By-Laws shall be changed to read as follows: "The President shall preside at the general meetings and shall perform such duties as custom and parliamentary usage require. On the morning of the first day of the annual session following his election, he shall deliver an address at the general meeting not exceeding forty minutes in length. He shall also deliver an address and make a report before the House of Delegates at their first meeting of an annual session."

DUTIES OF SPEAKER AND VICE SPEAKER

WHEREAS, an amendment to Article IX, Section 1, of the Constitutional By-Laws has been proposed which would create the office of Speaker of the House of Delegates, be it therefore

Resolved, that the following sections be added to Chapter VIII of the Administrative By-Laws:

Section 6. The Speaker.—The Speaker shall preside at the meeting of the House of Delegates and shall perform such duties as custom and parliamentary usage require. He shall have the right to vote only when his vote shall be the deciding vote.

Section 7. The Vice Speaker.—The Vice Speaker shall officiate for the Speaker in the latter's absence or at his request. In case of death, resignation or the removal of the Speaker, the Vice Speaker shall officiate during the unexpired term.

OTTO U. KING, *General Secretary.*

Announcements

CALENDAR OF MEETINGS*

NATIONAL SOCIETIES

American Academy of Periodontology, August 20-21, 1926, New York City.

American Dental Assistants Association, August 19-21, 1926, Philadelphia, Pennsylvania.

American Dental Golf Association, August 27, 1926, Philadelphia, Pennsylvania.

American Dental Hygienists Association, August 23-24, 1926, Philadelphia, Pennsylvania.

American Society of Oral Surgeons and Exodontists, August 20-21, 1926, Philadelphia, Pennsylvania.

American Society of Orthodontists, August 16, 1926, New York City.

Federation of American Women Dentists, August 23-26, 1926, Philadelphia, Pennsylvania.

First International Orthodontic Congress, August 16-20, 1926, New York City.

International Orthodontic Congress, August 16-20, 1926, New York City.

National Association of Dental Examiners, August 21, 1926, Philadelphia, Pennsylvania.

Seventh International Dental Congress, August 23-27, 1926, Philadelphia, Pennsylvania.

Xi Psi Phi Fraternity, National Alumni Chapter, August 21, 1926, Philadelphia, Pennsylvania.

Canadian Dental Association, August 16-19, 1926, Halifax, N. S.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

National Capital at Washington, D. C., first Tuesday of every month.

July (1926)

Wisconsin, at Milwaukee (13-15).
Wyoming, at Lander (12-13).

August (1926)

Pennsylvania, at Philadelphia (23-27).

October (1926)

Florida, at Daytona.

November (1926)

Arizona, at Phoenix.

December (1926)

Nevada, at Reno (4).
Ohio, at Columbus (7).

Odontological Society of Western Pennsylvania, at Pittsburgh, November 29-December 1, 1926.

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Montana, at Helena, July 12-16, 1926. Secretary, Marshall E. Gates, Helena, Montana.

North Dakota, at Fargo, July 13-16, 1926. Secretary, W. E. Hocking, Devils Lake, North Dakota.

*Announcements must be received by the ninth of the month in order to be published in the forthcoming issue of **THE JOURNAL**.

AMERICAN DENTAL HYGIENISTS ASSOCIATION

The American Dental Hygienists Association will hold its annual meeting, Aug. 23-24, 1926, at the Evans Dental Institute, Fortieth and Spruce streets, Philadelphia, Pa. This will be a business meeting. All members are urged to attend.

LEONA M. MITCHELL, *Secretary.*

NATIONAL ASSOCIATION OF DENTAL EXAMINERS

The National Association of Dental Examiners will meet in Philadelphia, Pa., Saturday, August 21, 1926, at the Bellevue-Stratford Hotel.

W. E. HOCKING, *President,*
Devils Lake, N. D.
GEORGE L. POWERS, *Secretary,*
Memphis, Tenn.

SOUTHWESTERN SOCIETY OF ORTHODONTISTS

(Change of Date)

The sixth annual session of the Southwestern Society of Orthodontists will be held in Houston, Texas, Aug. 4-7, 1926. Sixty or more members with their wives will sail from Galveston, Aug. 7, for New York, to attend the International Orthodontic Congress in New York and the International Dental Congress in Philadelphia. A cordial invitation is extended to any ethical dentist to join this party. A round trip rate may be had via Houston, boat to New York, and home over any railroad. Kansas City round trip rate, $126.77. Consult your local agent or write to Dr. P. G. Spencer, Amicable Bldg., Waco, Texas.

XI PSI PHI FRATERNITY, NATIONAL ALUMNI CHAPTER

The Xi Psi Phi Fraternity headquarters will be the Penn Athletic Club. A business meeting will be held, Saturday, Aug. 21, 1926, and a banquet will be given, Thursday, August 27.

J. F. ALCORN, *President,*
Metropolitan Bldg., St. Louis, Mo.
G. W. HILLIAS, *Sec'y-Treas.,*
Bryant Bldg., Kansas City, Mo.

MONTREAL FALL CLINIC

The Montreal Fall Clinic, under the auspices of the Montreal Dental Club, will be held for the second time, Nov. 1-3, 1926, in the clinic section, A. L. Walsh, General Hospital, Montreal.

A. N. JENKS, *President.*

AMERICAN DENTAL ASSISTANTS ASSOCIATION—OFFICIAL NOTICE

To the Presidents and Secretaries of the Constituent Societies of the American Dental Assistants Association:

You are hereby notified that the second annual session of the American Dental Assistants Association will be held at Philadelphia, Pa., August 19-21, 1926.

The constituent societies are hereby notified to file with the general secretary of this association, at least thirty days prior to the first day of the annual session, a list of the names and addresses of their delegates and alternates.

Program

The official program will be mailed to the members of the association prior to the annual meeting.

Thursday, August 19—

Registration	8 a. m.
Meeting of the house of delegates	9 a. m.
General session	2 p. m.

Friday, August 20—

Meeting of the house of delegates	9 a. m.
General clinics for dental assistants	2 p. m.

Saturday, August 21—

Meeting of the house of delegates	9 a. m.
Election of officers	
Annual luncheon	1 p. m.

The sessions will be held in the Hotel Pennsylvania and the Thomas W. Evans Institute of Dentistry, Fortieth and Spruce Sts.

The annual luncheon will be held at the Hotel Pennsylvania, Saturday, August 19, at 1 o'clock. An interesting program has been arranged. Prominent members of the dental profession and able speakers will attend.

Headquarters will be the Hotel Pennsylvania, Thirty-Ninth and Chestnut Sts. All those desiring to make reservations for rooms, should do so as soon as possible, directly with the Hotel Pennsylvania. Special rates have

been secured of $3.00 a day per person, three in one room.

No certificates for reduced railroad fare will be issued this year. The excursion rates to Philadelphia will be approximately on the basis of one and one-half fare for the round trip.

All dental assistant societies which are not affiliated with the American Dental Assistants Association are invited to send representatives to the meeting. Members of the dental profession and dental assistants are cordially invited to attend the sessions.

JUILETTE A. SOUTHARD, *President*,
174 W. 96th St., New York City.
ANNA H. SYKORA, *General Secretary*,
No. 8 W. 40th St., New York City.

CANADIAN DENTAL ASSOCIATION

To the Members of the Dental Profession in the United States:

As President of the Canadian Dental Association and on behalf of the profession in Canada, it gives me pleasure to extend greetings and a cordial invitation to you to attend our meeting in Halifax, August 16-19, 1926. The dates have been arranged for the convenience of those who wish to attend the International meeting in Philadelphia and there will be ample time after our meeting to reach Philadelphia by motor, rail or steamer, for that event. During the last few years, relations of the American and Canadian Dental Associations have been growing closer, one marked evidence of this being the merging of the Canadian with the American Dental Schools in an international association. It is with the desire to further promote this friendly relationship and to cooperate in the solving of the tremendous health problem in which dentistry is such an important factor, that we hope to welcome you to our Dominion on this occasion. For the same reason, we hope there will be a large representation of our profession from Canada at the international meetings. Complete information with regard to routes and accommodations, etc., will be found under society announcements.

Yours fraternally,
GEORGE KERR THOMPSON, *President*.

GOLF TOURNAMENT

The American Dental Golf Association will hold its seventh annual tournament at Philadelphia, Friday, August 27. The annual Calcutta pool dinner will be held at the Penn Athletic Club, Sunday evening, August 22, at six o'clock.

The Association is expecting the largest attendance since its organization, and in order to give every man an opportunity for winning the championship, two wonderful courses have been secured for the tournament—the Manufacturer's Country Club and the Philmont Country Club.

Many handsome prizes and trophies will be on display in the Commercial Museum (golfing headquarters) during the entire week of the International Dental Congress. Among them will be a moving picture camera, presented by The Williams Gold Refining Co.; the Listerine Cup, presented by the Lambert Pharmacal Company; the Oral Hygiene Cup, presented by Oral Hygiene, Inc.; cup presented by the Southern California Dental Golf Association; and many others with which any golfer would be delighted.

Begin now to rub up your clubs (and your game) and prepare for the greatest time you have ever had. To you who are out of the fold, come join the ranks—once a member, always a member.

Any information will be gladly given by
THOMAS P. HINMAN, *Secretary*,
Fourth National Bank Bldg., Atlanta Ga.
R. E. DENNEY, *Vice-President*,
Medical Arts Bldg., Philadelphia, Pa.

MIDWESTERN ASSOCIATION OF ANESTHETISTS

The annual meeting of the Midwestern Association of Anesthetists will be held, October 11-14, 1926, in Kansas City, Mo., at the same time as the Clinic Week there. Headquarters will be the Baltimore Hotel. An interesting and attractive program is in the process of making and any physician or dentist desiring to read a paper should send the title to the secretary soon.

RALPH M. WATERS, M.D., *Sec'y-Treas.*,
425 Argyle Bldg., Kansas City, Mo.

FIRST INTERNATIONAL ORTHODONTIC CONGRESS

Essayists of the First International Orthodontic Congress, to be held in the Hotel Commodore, New York City, August 16-20, and preliminary notice of which appeared in the June issue of THE JOURNAL, will be as follows: From America: A. H. Ketcham, Denver, Colo.; J. Lowe Young, New York City; H. A. Pullen, Buffalo, N. Y.; A. LeRoy Johnson, J. L. Appleton and L. S. Rittershafer, Philadelphia, Pa.; Percy R. Howe, Boston, Mass.; J. A. Detlefsen, Philadelphia, Pa.; R. C. Derivaux, Nashville, Tenn.; James D. McCoy, Los Angeles, Calif.; Milo Hellman, New York City; William K. Gregory, New York City. From other countries: A. C. Lockett, London, England; Georges Villain, Paris, France; Paul Simon, Berlin, Germany; Harold Chapman, London, England; Cale Matthews, Birmingham, England; Corrado D'Alise, Naples, Italy; Oswald Rubbrecht, Ghent, Belgium; Prof. Dr. Kantorowicz, Bonn, Germany; Albert Kadnor, Hamburg, Germany; G. Isard, Paris, France; Sheldon Friel, Dublin, Ireland; Angelo Chivaro, Rome, Italy; Axel Lundstrom, Stockholm, Sweden; Prof. Dr. Rudolf Schwarz, and J. H. Babcock, London, England. In addition to the literary program, clinics will be presented and study classes held, the latter under the direction of Joseph D. Eby, Oren A. Oliver, Clarence O. Simpson, Lourie J. Porter, B. E. Lischer and P. L. Stanton. A formal banquet will be held Wednesday evening, August 18, and the afternoon of Thursday, August 19, will be given over to recreation in the form of golf, swimming and sight-seeing.

SANITARY CODE AND REGULATIONS GOVERNING THE CONDUCT AND MAINTENANCE OF ROENTGEN-RAY LABORATORIES IN THE CITY OF NEW YORK.

The following communication has been received by the Editor of THE JOURNAL from the Office of the Commissioner of the Division of Illegal Practice of Medicine, Department of Health, City of New York, under date of May 24, 1926:

"Recently the Sanitary Code of the New York City Department of Health was amended regarding use of an x-ray machine for diagnostic or therapeutic purposes. Quite a number of dentists have expressed surprise at the existence of this public health regulation of this work. Should space permit, will you kindly make a note relative to this regulation of the Department of Health, City of New York, that all dentists that receive your journal may be informed regarding this x-ray regulation."

(Signed) S. DANA HUBBARD, M.D.,
505 Pearl St., New York City.

SANITARY CODE

Section 107. No person shall maintain, operate or conduct an X-ray laboratory or advertise or hold out to the public that an X-ray laboratory is maintained, operated or conducted, wherein radiographs are taken, diagnoses made or human beings examined or treated by X-rays, without a permit therefor issued by the Board of Health, or otherwise than in accordance with the terms of said permit and with the Regulations of the said Board. (As adopted by the Board of Health, January 26, 1922.)

Regulations Governing the Conduct and Maintenance of X-ray laboratories in the City of New York. (Adopted by the Board of Health, January 26, 1922.)

Regulation 1. Information to be furnished by applicant. Every application for a permit to conduct an X-ray laboratory shall be made in writing on an official blank to be furnished by the Health Department and must contain the following information:

Location of building.
Location in building.
Character of building.
Name of owner of building. Address.
Name of applicant. Address.

If a corporation:—

(1) When and where incorporated.
(2) In what County certificate has been filed and date filed.
(3) Officers of the corporation.
(4) Place of business of the corporation.
(5) Full and accurate incorporate name.

If a partnership:—

(1) Names of persons composing partnership in full, with their places of residence.

If a trade name:—

(1) The full names of the person or persons doing business under such trade name.

(2) Complete and full trade name.
(3) Place of filing of certificate as required by the statute, and date filed.

Regulation 2. A duly qualified person to be in charge. Every X-ray laboratory shall at all times be in charge and under the direction of a duly licensed physician or other person who is licensed under the Laws of this State to diagnose and treat diseases and whose knowledge, experience and qualifications to operate and use an X-ray machine are satisfactory to the Health Department. (As amended by the Board of Health, Feb. 6, 1926.)

Regulation 3. Precautions against danger. Every X-ray laboratory shall be so constructed as to confine within the operating room the rays emanating from the machine and it shall be equipped with suitable and necessary appliances and devices at all times when the X-ray machine is in operation for the proper protection of patients, operators and all other persons or property adjacent, contiguous to or coming in contact with the electrical or other current or force or spark generated or incident to the operation and use of the X-ray machine.

Regulation 4. Permits may be revoked in the discretion of the Board of Health.

Regulation 5. No permits shall be transferable as to the person or place. A permit is issued to a particular person, firm or corporation and for a given location and is not valid for use by any other person or in any other place than stated in the application for a permit.

SEVENTH INTERNATIONAL DENTAL CONGRESS

The hours not occupied by the Seventh International Dental Congress in Philadelphia next August 23 to 27 in deliberations and official transactions will find the delegates almost overwhelmed with a program of entertainment and diversion. This program, which is rapidly nearing completion, is being arranged by the entertainment committee of the Committee on Local Arrangements.

It is most broad in its appeal. Not only will it afford diversion and social relaxation to the fifteen to twenty thousand delegates who will attend the Congress, but it will also give them educational and professional contact.

Besides the Sesquicentennial International Exposition, there will be more than sufficient to keep the delegates busy during the hours the Congress is not in actual session.

For sightseeing, Philadelphia is exceptionally endowed. Being the birthplace of the nation, it has a wealth of historic interest, especially if the visitor is an American of patriotic instinct and a student of the history of his country. He will avail himself of the chance to view the Liberty Bell, Independence Hall, the Betsy Ross house, Benjamin Franklin's grave, Carpenters' Hall, where the first Continental Congress met, historic Germantown, Valley Forge and other revered spots almost without number. The Philadelphia hosts of the Dental Congress are completing plans for tours of all these historic spots during Congress week.

These places and relics hallowed by the nation's history are actually the focal points of the Sesquicentennial celebration which Philadelphia and the nation are observing this summer. The Sesquicentennial signalizes the 150th anniversary of the signing of the Declaration of Independence. Many individual events of this all-summer historic celebration will include these spots in their ceremonies and, as the events will be in full course in August, the Dental Congress delegates will find diversion in these.

The President of the United States will open the Dental Congress, and will, during his stay in the city for that purpose, participate in events identified with the historic anniversary.

An important sightseeing trip which has been arranged for the visitors is to Valley Forge, where, in the winter of 1777-78, the Continental Army, under General Washington, endured rigors and privations, when the War of the Revolution was at its lowest ebb. This trip is through a score of miles of beautiful country, everywhere replete with historic association. Sightseeing busses and automobiles will convey the dentists who elect to take the trip.

A stopping place on this trip will be the fine Gothic chapel erected on Valley Forge's hallowed ground by patriotic societies and citizens in tribute to the heroic Continental Army. Women of the societies which undertake the maintenance of this architecturally and patriotically remarkable fane will serve luncheon to the dental visitors in a grove adjoining the chapel.

Another trip will be to Kennett Square, a spot famed in song, story and history, the

Airplane view of Sesquicentennial site, with Philadelphia Navy Yard in the foreground.

journey to which lies through immortalized country, as witness Bayard Taylor's "The Story of Kennett." The objective point on this trip will be the wonderfully laid out estate of Pierre S. duPont, famed for its botanical gardens and landscape effects, and here the visitors will be Mr. duPont's guests at tea.

There will be a trip to Atlantic City, the famous "playground of the world," which is an hour's ride from Philadelphia. The special train will leave in the afternoon and return to Philadelphia that night, so the delegates may attend the Congress the next day. Arrangements will be made for stopover by those who desire, and there will be trips to the resort after the adjournment of the Congress. Atlantic City, the most cosmopolitan resort in the world, frequently accommodates more than half a million sojourners.

Drives through Fairmount Park, one of the largest public pleasure grounds in the world, will also be included in the entertainment itinerary.

In Fairmount Park is not only combined the beauty of Nature in its primeval state with the most ambitious effort of the landscape engineer, but the park has numerous historic spots. The latter feature is provided mainly by the estates of families prominent in the Colonial and Revolutionary periods, these estates forming the nucleus of the park. There are, for instance: "Lansdowne," the seat of John Penn, colonial governor of Pennsylvania; "Mount Pleasant," once the home of Benedict Arnold, purchased by him for his wife, Peggy Shippen, and confiscated by the state when Arnold's treason became known; "Lemon Hill," the country house of Robert Morris, financier of the Revolution, within whose walls Washington, Franklin, Jefferson and Lafayette were frequent guests; "Belmont," the Revolutionary country seat of Judge Richard Peters, patriot and Secretary of War; "Woodford," in whose ancient garden are the famous "Franklin trees;" "Strawberry Mansion," "Rockland," "Ormiston," "Sweetbriar," "Edgeley;" each the former estate of a family dating back to early times. All are now parts of the park, and each mansion is open to the public, some containing relics of their original owners and mementos of the nation's history. There are other relics, such as William Penn's house, the poet Tom Moore's cottage and General Grant's battlefield cabin. Penn Treaty Park, where William Penn made his treaty with the Indians for the purchase of Pennsylvania; and Bartram's Gardens, the estate of the celebrated naturalist, which are in other parts of the city, are also public property.

There will be personally conducted trips to the Sesquicentennial Exposition and many other trips.

Philadelphia contains many collections of art and scientific material. The new Museum of Art, erected at the entrance to Fairmount Park, will be formally opened during the Sesquicentennial and will contain an exceptional display of painting and sculpture, the gift of public spirited citizens. Other collections are in the Academy of the Fine Arts, the Pennsylvania Museum in Fairmount Park, the Johnson collection, etc.

Shopping tours to the fine stores of which Philadelphia boasts will be arranged, as well as other entertainment, of a social and amusement nature, especially for the women in attendance.

There will be a formal entertainment each night in honor of the delegates. The American Dental Association, the Pennsylvania State Dental Association and the dental professional bodies of the city, as well as the collegiate faculties, fraternities and organizations, will vie in entertaining the visitors.

On Tuesday night of Congress week, the Congress banquet will be held, in the ballroom of the Bellevue-Stratford Hotel. A reception by the officers of the Congress will be held later in the night.

Receptions to officers of the Congress and of the Fédération Dentaire Internationale and to the distinguished practitioners are being arranged.

The program of entertainment is being so arranged that events will in some instances be simultaneous, so that the delegates will have alternative events to attend when lack of hall space or accommodations limit the attendance at any event.

The committee on entertainment is headed by Dr. J. Clarence Salvas, as chairman, and comprises Mrs. Matthew H. Cryer, and Drs. John M. Fogg, J. C. Curry, Herbert Parcher, Jr., and Agnew Irwin.

There will be no dearth of entertainment, it can be perceived, with the preparations this committee is making.

Its companion committee, that on hotels and accommodations, again sounds a warning to those who are contemplating attendance at the International Congress to make early

reservation of accommodations. The hotel space is limited, owing to the presence of other conventions in Philadelphia at the same time.

It is of the utmost importance that every dentist who has the slightest intention of attending the Congress communicate at once with the management of one of the Philadelphia hotels, or other housing agencies, and make reservations.

The officers of the Dental Congress draw attention to the fact that only those holding cards of membership in the Congress will be admitted to its meetings.

Members of the American Dental Association are, by virtue of their membership in good standing in that body, active members of the Congress. The rules of the Congress provide that any national dental body may join on behalf of its members, paying a fee of $1 per head. Associate membership, with admission to the Congress, is provided for members of the medical profession and of other scientific professions, on payment of $10 each.

Dental students can be admitted to the meetings on the payment of a $5 fee, covering the entire Congress, and on being vouched for by the dean or other officer of the dental school they attend. Visitors to the Congress who are not eligible for membership, such as the families of members, may gain admission to its meetings on payment of $5 for each person. Dental practitioners in this country not members of the American Dental Association are not eligible to admission to the meetings.

RESOLUTIONS ON THE DEATH OF DR. CHARLES G. DAVIS

WHEREAS, It has pleased the Almighty God, in his inscrutable wisdom, to remove by death our esteemed and useful brother in the profession, Dr. Charles G. Davis, and

WHEREAS, the Plainfield Dental Society of the State of New Jersey has suffered the loss through death of Dr. Charles G. Davis, whose sudden passing away on January 12, 1926, has deprived us of the fellowship of one who has been an esteemed and active member since the inception of this society, and

WHEREAS, in the death of Dr. Davis, this society, as well as the profession, has lost a valued member, therefore, be it

Resolved, That the Plainfield Dental Society extend its sincere sympathy to Mrs. Davis and to his father, his mother and sister, in their bereavement, which is the bereavement of the state as well as of the Plainfield Dental Society, and be it further

Resolved, That a copy of these resolutions be spread upon the minutes, sent to the members of his family, and to the dental journals for publication.

PLAINFIELD DENTAL SOCIETY,
Plainfield, N. J.

BOOK REVIEW

Modern Dental Materia Medica, Pharmacology and Therapeutics, Including the Practical Application of Drugs and Remedies in the Treatment of Disease. By J. P. Buckley, Ph.G., D.D.S., F.A.C.D., Professor and head of the Department of Materia Medica, Pharmacology and Therapeutics, and formerly Director of the Chemical Laboratories, Chicago College of Dental Surgery, Dental Department of Loyola University; President, Odontographic Society of Chicago, 1905; President Illinois State Dental Society, 1916; and President American Dental Association, 1923. Philadelphia: P. Blakiston's Son & Co. Ed. 5, revised; 205 illustrations; pp. 586. Price, $6.00.

The fact that this splendid work has gone into the fifth edition is ample evidence of its merit. In the present edition, the book has been brought to date, and it thus contains the latest theories on all of those subjects which are embraced in its scope. It is well written, and the mechanical make-up of the book is beyond criticism. The colored plates used in some of the illustrations add to the attractiveness and value of the book, and the entire work is certain of a cordial reception on the part of the profession.

THE CHALLENGE OF INTEGRITY

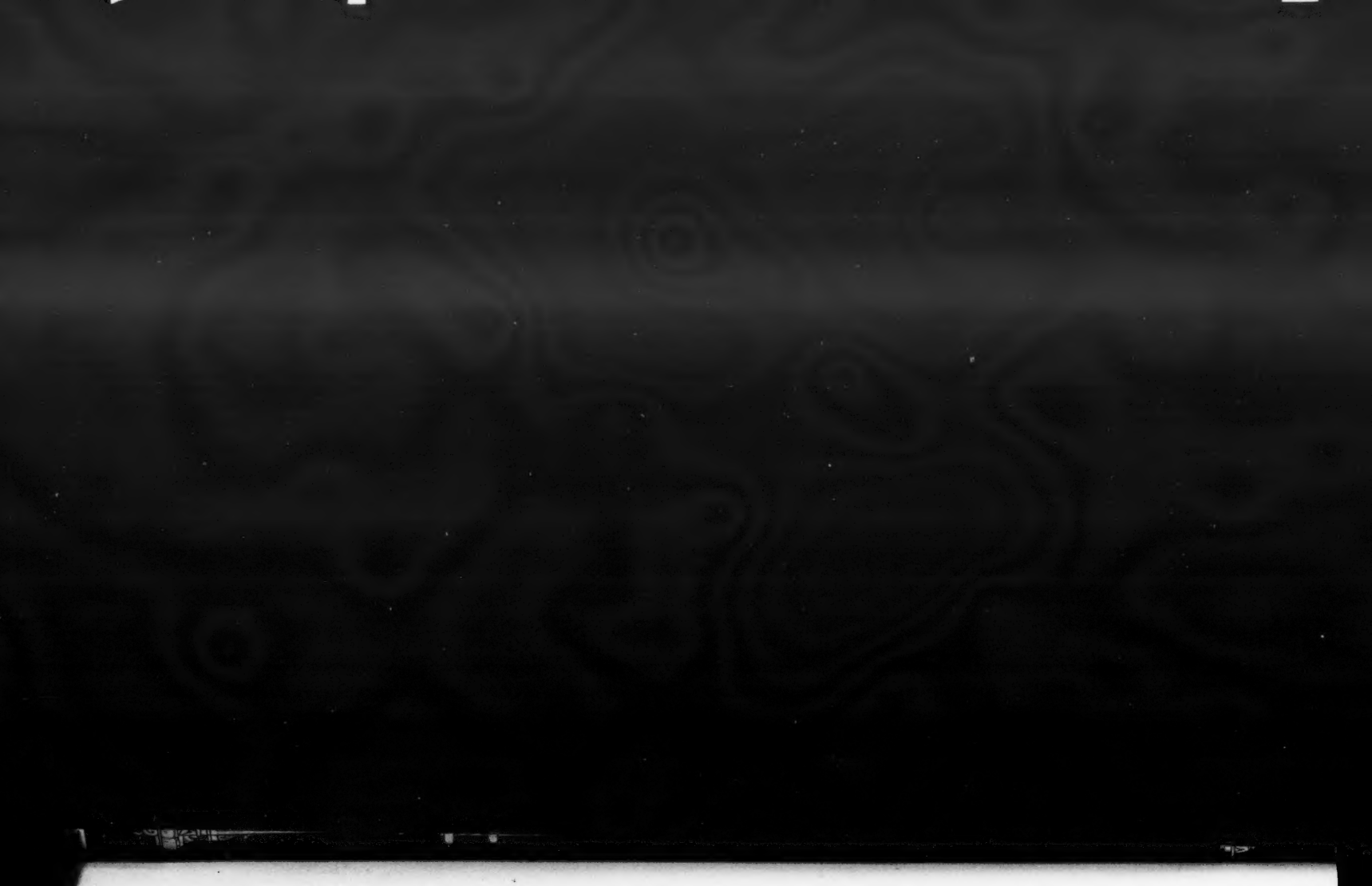
By Ernest V. Madison

In this issue of THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION are many advertisements of products manufactured for the dental field.

The advertisers say, in effect: "*Here, buyers, sellers and users are our products. They are made as well as we can make them. They are free from defects and inferiorities. We challenge you to find weakness or deception—to find better values.*"

This advertising attitude on the part of these manufacturers is an admirable one. They come out in the open—bid fair and above board for patronage—welcome a critical inspection. They call forth *the challenge of integrity.*

We should honor their fair, manly stand by a preference for advertised products

—by granting them the audience they seek in this issue of THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

—by turning through the advertising pages *now.*